



TANGANYIKA

DEPARTMENT OF AGRICULTURE

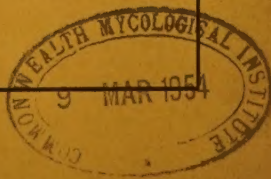
Technical and Specialist Officers'

Reports for the year 1951

1953

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SOIL CONSERVATION SERVICE, ANNUAL REPORT 1951

GENERAL

It is most gratifying to be able to report that the demands for assistance in establishing proper land use and soil conservation measures, both on native and alienated lands, show a steady increase, and that the work on hand, and projected, is such to keep staff and equipment fully occupied for at least two years.

One of the main demands from the Service has been the construction of terraces, diversion ditches, dams, etc., and results from the demonstration value of these on farms treated during the last two years. Such mechanical treatments are very often necessary but they are only a beginning in tackling the problem of complete conservation. Much remains to be done to obtain full use of supporting practices such as the adoption of balanced systems of farming, better farm planning, and the number of practices which, when applied together, give a completely protected and productive land unit.

The understanding that good farming is a soil conservation practice is becoming more and more appreciated and although necessary changes such as turn over from monocultural cropping to that of, say, mixed farming, are slow and costly, steps are being taken and, with the co-operation of the other departments concerned, progress is being made.

The devastation caused by serious, unchecked soil erosion is recognisable by all and, naturally, the first requests for assistance are to treat such areas, but where the erosion processes are not marked or spectacular in appearance it has not been so easy to induce the occupier of such land to take the necessary steps and then to expend time and money. Many of the areas treated by the service to date have been those in most urgent need of protective works and have been the most difficult on which to establish sound measures. The early policy of undertaking the treatment of any land is being modified so that as great an acreage as possible, with the staff and equipment available, receives early attention. Some individuals with problem areas may suffer but the gain is a more rapid application of soil conservation measures to a very much greater acreage.

The huge areas within the Territory where deterioration of natural resources continues at an alarming rate make the possibilities of checking such appear almost impossible, but the continued forming of Provincial and District teams is a hopeful trend. The co-ordination and co-operation between departments concerned with the use and development of natural resources and the Provincial Administration is steadily building up, and this concept of a balanced overall treatment has already, in some areas, obtained a most marked progress.

At all times the Soil Conservation Service has been available for field assistance or technical advice and much time of the staff has been given to this work, in addition to operational work. The Service staff, being fully occupied with land use problems and soil conservation treatments in many parts of the Territory, is steadily accumulating data and experience through meetings and training courses. This knowledge is made available to field staff. With the strengthening and training of staff of the departments concerned more rapid progress can be obtained, but not for many years can it be anticipated that it will be possible to do more than our best, preventing the worst forms of exploitation and misuse of natural resources.

STAFF

The establishment of the Service was, during the year, brought up to full strength, and this, coupled with greater experience and training, has resulted in a great increase of output of work. With the staff increase it was possible to post officers to the Southern Highlands Province, and for an increased number of tours to be undertaken to other parts of the Territory.

Further recruitments of African staff were made and these given training courses; a number of these men were trained for posting to the Southern Highlands. Although there has been a certain amount of retirements and dismissals of African staff, on the whole the work and behaviour of surveyors, mechanics, drivers and others have been very good and, without the high standard they have shown, progress of work in the field would not have been at the rate attained. It is felt that the African staff know they are doing a worth-while job, seeing the value of their work, and have responded by giving of their best under very hard working conditions.

SOIL CONSERVATION CENTRE, TENGHERU

The development of this centre is still proceeding. The original building programme having been completed the improvements in layout of the Station and further opening up of the research and demonstration area were the main works during the year. The establishment of the proposed Natural Resources School at Tengheru requires alteration to be made to the layout of the Soil Conservation area, and, following surveys, a plan was agreed to requiring some of the Service's buildings to be handed over to the School, and new buildings to be erected in replacement.

The Tengheru Centre fulfils three main purposes, first, as the headquarters, of the Service with its mechanical workshops, stores, etc. Secondly, as a training centre for both European and African staff, and, thirdly, as a research and demonstration centre. It has proved most valuable but, with the expansion of work to more distant parts of the Territory, further facilities will have to be provided in these areas.

RESEARCH AND DEMONSTRATION

Some of the most valuable agricultural lands of the Territory are those of the mountain areas. Most of these carry dense native populations and,

under cultivation, on their steep sloping lands which have in many cases a high rainfall, soil erosion is a serious problem. For other areas information can be drawn from the United States of America where a wide research programme has given data which, with some modifications, can be applied to our conditions. The first steps taken at Tengeru, when land became available last year, was to start investigations as to suitable treatments of the steeper sloping lands. These observation plots and trials have been continued and further trials laid down.

The following are the results from the main trials for 1951 :—

Bench Terracing v. Flat Cultivation

This experiment of replicated plots was laid down on a twenty-five per cent slope, and has three treatments.

- (a) Made Bench Terraces at 6' and 3' vertical interval made by hand.
- (b) Formed Bench Terraces. Barrier hedge of elephant grass planted at 6' and 3' V.I.
- (c) No treatment.

Results

Year	(a) Made Bench Plot Yields	% of best	(b) Formed Bench	% of best	(c) Flat	% of best
1950 ...	129.5	70	155.6	84.3	184.6	100
1951 ...	57.1	100	30.6	53.6	50.0	87.6

In the first year the disturbance of the soil in making bench terraces, and the planting of elephant grass to form benches, depressed the yield below that of the untreated plots. This season the made bench terraces gave the highest yield. The quick recovery of the made bench plots for our conditions is most satisfactory, and opens up the possibility of an extensive use of this treatment as it is anticipated the complete stabilisation of the soil following this treatment will lead to yields being maintained, if not increased, whilst the untreated plots are steadily deteriorating, rill erosion being most evident on them this last season.

Elephant grass barrier hedges for the formation of bench terraces are most efficient but they have, in this trial, seriously suppressed crop growth, and further investigations are required to ascertain the minimum distance between such hedges which, in turn, will fix the degree of slope on which such a method of forming benches can be used.

Hillside Cultivation Trial

A series of single observation plots was laid down in 1951 on a twenty-five per cent slope, the following treatments being given :—

- (a) Matengo Pit System.
- (b) Ridge cultivation.
- (c) Ridged-and-tied.

- (d) Made bench terraces.
- (e) Formed bench terraces.
- (f) Narrow base contour banks.

Results

Treatment	Yields in lb. Maize		% of Highest Yielding Treat- ment		Order of Yield	
	1950	1951	1950	1951	1950	1951
(a)	235.5	129.5	100	100	1	1
(b)	204.0	56.0	87	43	3	4
(c)	220.0	63.0	93	45	2	2
(d)	187.5	57.0	80	44	4	3
(e)	175.5	28.0	75	22	5	6
(f)	152.5	35.0	65	27	6	5

The marked superiority in yield for both years of the Matengo Pit System is of interest, and, although the large amount of labour necessary to construct them precludes its general application to native areas, a modified system may be of value, as the high yields were given in a year of moderate rainfall and one of very heavy rainfall.

The yield difference between made bench terraces, ridge cultivation and ridged-and-tied cultivation is small, and all are satisfactory treatments, indicating a general recommendation that the steeper slopes be benched, with the more moderate slopes ridge cultivated.

The low yields obtained from the contour banks are mainly due to the high proportion of land taken out of use by this treatment, and it has little value for protection of the steeper slopes.

Made Bench Terraces at Vertical Intervals of 1'—6'.—Originally laid down to ascertain the number of man-days to construct bench terraces at varying vertical intervals; the effect on yield has also been taken.

Results

Vertical Interval	Slope 22% Width of Terraces for Planting		Number of man-days to construct
1'	4'	...	98
2'	8'	...	116
3'	12'	...	163
4'	16'	...	253
5'	20'	...	218
6'	24'	...	262

MAIZE YIELDS

Vertical Interval	Yields in lb. Maize		Yield as % of Highest Yield		Order of yield	
	1950	1951	1950	1951	1950	1951
1'	233.5	34.0	95	40	2	6
2'	246.5	54.5	100	65	1	5
3'	233.5	84.0	95	100	2	1
4'	183.5	65.5	74	78	4	2
5'	150.5	64.0	61	76	6	4
6'	159.5	64.5	65	77	5	3

In the first year better yields were obtained from the bench terrace with the smaller vertical interval, these giving shallow cuts into the subsoil, but already in this second year with the mellowing of the soil on the large benches the relative yields from these have greatly improved. As narrow benches, resulting from the use of a small vertical interval, are difficult to work, and a large number of terrace faces have to be maintained, it is obvious that the choice should be the larger vertical intervals, taking into account the value of the land and the cost of construction.

Mulching Trial.—Two observation plots were laid down this season on an eight per cent slope to ascertain the effect of "stubble mulching" in this case leaving maize stalks on the surface, the bulk of the material being approximately ten tons per acre.

Results

Treatment				Yield lb. Maize	% of best Yield	Soil Loss lb./acre
Mulched ...	...	...	...	105.5	24	1,540
Unmulched	...	...	...	440.0	100	10,490

The mulch was effective in greatly reducing soil loss although at the rate applied it was thin on the ground. The low yield of the mulched plots in comparison to the unmulched is contrary to results obtained from mulching trials in other parts. During the growing season, which was one of long protracted cold rainy spells, the growth of the maize on the mulched plots at all times was much poorer than that on the unmulched. Further investigations are to be carried out to ascertain if the results were due to an upsetting of the C/N value due to the maize stover lying on the surface, or to the waterlogging due to a greater infiltration of the rainfall.

Further Trials.—Three additional trials were laid down, but it is still too early to draw conclusions as to the value of treatments. The first of these was to try out different systems of making bench terraces so as to avoid an immediate exposure of the subsoil. The second was to use elephant grass barrier hedges planted on a grade of 1 : 200, on moderate slopes so that the horizontal distance apart was 45'—75' so that channel bench terraces would be formed. Even on the moderate slopes the soil movement has been considerable and approximately one-foot depth of soil has been held up by the barrier hedge. The third trial was of seven plants of possible value for use as barrier hedges, in order to try to obtain something to replace elephant grass where short horizontal distances have to be used on steep slopes.

The irrigation experiments proposed have been laid down but planting has yet to be done. Demonstration waterways and V ditches were constructed for demonstration purposes and a number of species of grasses and other plants planted in them to ascertain their value in protecting these vegetated waterways.

PLANT INTRODUCTION AND TRIALS

A large number of grasses and legumes, both introductions and indigenous, have been planted, a number of which have already proved of value for particular purposes. The best of these plants are :—

Pennisetum salifex.—A useful strong-growing grass for the protection of steep slopes and large waterways.

Digitaria swazilandensis.—A close-growing turf—forming creeping grass, proved the best for the protection of bench terrace faces and small ditches.

Star Grass and Giant Rhodes Grass.—Both have proved excellent grasses for leys, giving very high yields. The former has to be propagated vegetatively, and trials have been made of possible methods to permit farmers to do this cheaply.

East Indies Bluestem and Australian Bluestem. (*Andropogon ischaemum* and *intermedius*).—Both are proving useful grazing grasses and plants for hay in the drier areas.

Of the remaining grasses a number show promise and planting material has been distributed to ascertain their value under varying conditions.

Legumes.—The original collection from the United States of America is being maintained, of which Hubam Clover and Tropical Kudzu are the most useful. During the year three edible lupins were tried out and made satisfactory growth, and may be useful as green manure crops.

Two local legumes *Dolichos formosus* and *Glycine javanica* have under conditions of good cultivation, shown very good development and the former much relished by stock, may prove a very valuable soil building crop to incorporate in crop rotations for mixed farming.

There has been a steady demand for planting material from the Station, and parcels of seed, rooted material and trees have been issued to local farmers and to other parts of the Territory.

EDUCATION

With our increase in staff it was possible to give much more time to the training courses held at Tengeru. Two courses for European staff were held, the first from March 15th to 12th May; ten Agricultural Assistants attended. The second from 27th August to 6th October was attended by twelve Agricultural Assistants and one Livestock Officer.

Although these courses take up a considerable amount of the time of the officer concerned there is no doubt of their value. The great interest and attention paid by those who took part in the courses, and the results of examinations, give the assurance that field staff attending them will do much to further proper land use and soil conservation in the areas to which they are posted.

During the off season when field work could not be carried out field staff of the Service was brought in and a refresher course in elementary surveying and arithmetic was given to them.

With the opening up of work in the Southern Highlands Province the need for additional surveyors required the recruitment and training of extra staff, and a four months' training was given to twelve probationary surveyors.

Twelve Agricultural Instructors from the Uluguru Land Usage Scheme were given a two months' course.

Twelve Instructors of the Usambara Scheme received a month's training.

Five Senior Instructors from the Usambara Scheme spent a week at Tengeru, also seeing work carried out in the Arusha District.

In addition to set courses a large number of visitors have been taken round the Station, including a party of twenty-six pupils from the Kilimanjaro Native Coffee Union School at Lyamungu.

Proposals have been submitted for the holding of short courses in Land Use Planning and Soil Conservation for members of the Provincial Administration. The first of these is to be held early next year.

The obtaining of photographic equipment has allowed the preparation of a number of studies of land forms, soil erosion, conservation practices, etc., in Tanganyika. These have been made up into slides both in colour and black and white for educational and propaganda work for both African and non-African students, and to illustrate lectures given at courses, held at Tengeru.

SHOW EXHIBITS

Following the great interest shown in our exhibits and models at the Mbeya Show, a more ambitious layout was prepared for the Iringa Show, and although one officer spent a considerable amount of time in preparing materials such as models, posters, photographs, etc., this was fully justified by the response of European and Africans attending the Show. Large crowds attended the exhibit, showing great interest and keeping the staff fully employed giving information.

The Singida Show was attended by an officer of the Service and although our exhibit was limited in scope, this was reinforced by the giving of talks and showing of slides of soil conservation works to native audiences during the Show period.

MAINTENANCE OF MECHANICAL UNITS

The work undertaken at Tengeru on the over-hauling and maintenance work on our tractors, machinery and motor vehicles was greatly increased during the year. With better organization, additions to workshop equipment, and the better trained African staff it was possible to attain an excellent record of keeping our field units in action. Despite a number of serious breakdowns due to hard working conditions the average for the whole season of all units was ninety per cent of full possible working hours.

With a total of twenty tractors, both crawler type and wheeled, four motor vehicles, and ancillary equipment such as graders, dam scoops and trailers, the work of the workshop staff was most arduous, but the freely given overtime

and, in some cases, night work, fully met the demand. Tremendous savings in both time and money were made by it being possible to undertake this work, and only in cases where special equipment was required was it necessary to put out repair work. The holding of stocks and spares was completely reorganized during the year and contributed much to a rapid repairs' service.

During the rainy season, from May to July, as much as possible of the field equipment was brought in and given complete overhauls. This included the following machinery—nine Allis Chalmers HD5 crawler tractors, one five-ton Bedford truck, one 30-cwt. Bedford, one Land Rover. In addition a new body was built on a 30-cwt. Bedford, one Ferguson trailer body was built, a 250-gallon water carrier was constructed, and a large trailer modified and rebuilt for the carrying of heavy tractors.

The officers responsible for mechanical maintenance spent much time training African staff, and now reliable mechanics are available for work with each group of mechanical equipment in the field, and at the base workshop. Our Africans working on machines still do stupid and sometimes unforgivable things, but much less frequently now than in the past.

OPERATION OF MECHANICAL UNITS

During the year the operation of mechanical units was greatly increased in an attempt to keep up with the large demand for work. It is possible that, as land users see more examples of active soil conservation works on the land, they will themselves undertake more of the simpler measures, freeing our heavy equipment to deal with major works.

Despite the difficult conditions under which most of the field work has been done a satisfactory output was obtained. The light, puffy volcanic soils encountered in many parts, and the areas of heavy, black clay soil, have provided few areas where terrace construction or other works were straightforward simple jobs. These conditions have been hard on both staff and machinery, and the former, both European and African, are to be congratulated on the programme maintained. A statement of works completed during the year is attached.

The main demand for assistance is from farmers whose land is being seriously damaged by erosion, and the treatment of these critical areas is much more intensive than that required for the protection of ordinary farm lands, so that the figure for acreage treated is not a true measure of the amount of work done on such lands.

Where possible an attempt has been made to induce farmers to close highly susceptible areas and lay them down to grass, and to concentrate their annual cropping on the gentler sloping lands. This has only been possible where the farms or holdings have sufficient of such land available and, in a number of cases, it was possible to arrange for necessary adjustments in boundaries to be made.

Experience of previous years' work has shown that the broad base terracing of the steeper slopes leads to great difficulties on the part of the farmers in terrace maintenance and, in order to treat as great an area as possible as quickly as possible, no slopes over eight per cent are being treated by broad based terracing, except for special cases.

Results of experiments at Tengeru and field trials on two farms are leading to a new approach and treatment of the steeper farm lands. A new type of forward-draining graded bench terrace is being used and this measure is favoured by farmers, and larger areas are now being treated.

During the period of heavy and protracted rains our mechanical structures were subjected to severe strain and only a few minor failures took place. With the obvious benefits obtained from treatments being demonstrated on a large scale the demand for assistance continues to increase.

Nichols and Wisconsin Terraces.—Modifications of standard specifications for earth structures are possible now that earlier works have passed through two seasons' rains. In some cases there has been an excessive safety margin, in others failures have shown that for special conditions changes are required.

In terracing work the main type of terrace constructed has been the Nichols terrace, with a certain acreage of Mid Western type. Both of these have proved satisfactory for use with ordinary farm equipment, but where large implements are used the side slopes of the channels and banks are rather too steep, and at Burka Estate the active interest and co-operation of the management enabled us to treat a large acreage with a new type of terrace, a wide V channel with no marked bank, the spoil being spread out on the land. These proved efficient during last season and caused no trouble where large farm implements were used. Additional acreages are being treated with this type.

In October three members of the Soil Conservation Service staff paid a short visit to Kenya to study soil conservation work. This was a most valuable trip, special attention being paid to the farming and maintenance of terraced land and the excellent work of farm planning being carried out in the Nakuru District. A local farmer who accompanied the party for a part of the visit was most impressed by this work and returned full of enthusiasm and ideas. Compared to the Kenya Soil Conservation Service the Tanganyika Service is still in the "teething" stage, but despite that the standards of construction of earth structures, and the work output obtained by comparable machines compares favourably with that of the sister Service. In farm planning and adoption of the many supporting practices we are a long way behind.

FARM DAMS

A further development during the year has been the undertaking of the construction of farm dams and hafirs. Originally started to keep our machinery and staff fully occupied when terracing and other works were precluded owing to crops standing on the ground, this has developed into a

lever to obtain soil conservation measures. Work on water storage is done only on farms or in areas where satisfactory soil conservation treatments are established. The provision of these farm dams is a direct soil conservation measure in that it permits the keeping of stock on dry farms and the establishment of a system of mixed farming, with its many supporting soil conservation practices.

The ten hafir dams were constructed in the Kissongo pilot area of the Masai Development Scheme where improved land is planned for these pastoral people. The three farm dams were constructed in the Loljoro area where the farmers have shown themselves a most progressive group in undertaking soil conservation.

SURVEYS AND FARM VISITS

During the year eighty-eight farms were visited to advise on necessary soil conservation works and, although there will be a considerable time lag in giving mechanical treatment to many of them, the marking out of waterways and preparing them well before terrace systems are established has proved an important first step.

One of the most promising results of a number of these visits has been the increasing interest shown in farm planning and the desire to establish better farming systems. This, coupled with the steps taken to form Soil Conservation Councils, should lead to improved land use practices. Actual surveys on farms were made to plan layout and treatments and 54,000 acres were covered this year, with the choice and inspection of suitable farm dam sites numbering forty-two.

Touring of officers of the Service to a number of areas in the Territory was carried out, and assistance given and plans drawn up for the treatment of large areas of country. Following these visits the most advanced progress has been in the Southern Highlands Province where staff and equipment have been placed, and already work is well in hand with the strong support of other departments in the area. Although the main work there deals with the large mountain masses occupied by native cultivators in the Rungwe, Mbeya and Njombe districts, special attention is being given to problems met with on tobacco farms in the Iringa district.

ADVISORY AND EXTENSION WORK

This has expanded during the year and, in addition to farm visits, representatives of the Service attended group meetings of farmers, district meetings, land utilization committees and two meetings of the Natural Resources Board. At all times endeavours are made to obtain close co-operation with other land use departments such as the Veterinary Department and its Pasture Research Organization, and the Forestry Department. The decision to house at Tengeru a part of the Hydrological Section of the Water Development Department was made and a preliminary programme of co-operative investigational work drawn up.

LAND USE LEGISLATION

A number of districts have introduced new land use legislation or revised earlier rules made under the Native Authority Ordinance, and Orders made under the Natural Resources Ordinance. The framing of rules to be made under the latter Ordinance is progressing and when brought into force will give the necessary powers to require good land use in serious cases of misuse of our natural resources.

CONCLUSION

As stated, progress is being made, and with a steady increase in the number of schemes for the proper development of lands and Rehabilitation Schemes (some well advanced), there is room for optimism. The impatience, too often felt, that the rate of progress is too slow to meet the situation has to be curbed, realising that sound land use planning can only be carried out with sufficient data on a number of factors concerned, and that rushed planning can lead to crippling mistakes being made, doing more harm to the aims and objects of soil conservation than some delay in framing sound policies based on a proper understanding of the problems to be dealt with.

D. THORNTON,

Chief Soil Conservation Officer

STATEMENT OF WORKS EFFECTED, 1951

Month	Acreage Terraced	Diversion Ditching in feet	Waterways in feet	Farm and District Roads in feet	Hafir Dams Construc- ted	Farm Dams Construc- ted	Motor- able Tracks Feet
January ...	1,130	16,700	4,700	2,500	—	—	—
February ...	590	22,800	5,200	2,500	—	—	—
March ...	400	10,000	3,000	2,000	—	—	—
April ...	71	3,000	—	—	—	—	—
May ...	—	—	—	—	—	—	—
June ...	30	—	400	84,480	3	—	158,400
July ...	203	3,800	—	—	3	—	30,000
August ...	230	4,000	3,800	—	4	—	8,000
September...	180	3,000	200	—	—	1	—
October ...	195	8,000	—	—	—	2	—
November...	300	3,600	2,000	—	—	—	—
December ...	360	4,000	3,000	—	—	—	—
Total ...	3,689	78,900	22,300	91,480	10	3	196,400

ADVANCE SURVEY:

Reconnaissance ... 54,000 (Terracing Farm)

FARMS VISITED:

Reconnaissance ... 88 (Farm Dams 42)

SUMMARY OF THE ANNUAL REPORT OF THE COFFEE RESEARCH STATION, LYAMUNGU, MOSHI, FOR 1951

During the last quarter of 1950 insufficient rain fell to bring out a flowering but very effective rain fell in mid-January and in February, 1951. These rains resulted in two very heavy flowerings, each with a high degree of setting, and also a tremendous flush of vegetative growth. The demands on the tree of the heavy set and the strong vegetative growth resulted in some cherry fall in March, all these fallen young cherry showed a blackening of one or both the young beans—a sign of carbohydrate deficiency at the particular level of cropping and vegetative growth.

Heavy rain occurred in both April and May as is usual and light, but effective, rain continued into August. Bright sunny periods were experienced in July and August, usually the sky is clouded over in these months. As a result a large proportion of the crop ripened very quickly and a month to six weeks earlier than usual. November was a very wet month and although rain at this time greatly assisted the maturing of the cherry left on the trees, it hampered the drying of the crop already picked. Appreciable rain also fell in December and brought out one or two small flowerings and swelled some very small flower bud.

By the end of December approximately eighty-three tons of parchment coffee had been harvested and it is estimated that a further five tons approximately remains to be picked, most of which will be dried in the cherry. The total area in cropping, including nine acres in their first bearing year, is $126\frac{1}{2}$ acres.

Three new experiments were planted during the year, each was designed in order to extend the information already obtained in other experiments. The first, Experiment IIIB, is an extension of Experiment IIIA in which it has been found that over a period of six years there is no significant difference in the yields of clones and seedlings of the same parent tree. Experiment IIIB is designed to compare the yields of the original parents of three selections (N5, N39 and H66) with second generation seedlings and clones and seedlings of clones. The second, XVIII A, consists of two 6×6 Latin squares and is designed to compare the suitability, as judged by yield, of each of the selections in the experiment to the single and multiple stem systems of pruning. The third experiment is designed to ascertain the effect, on yield, of various modifications of the standard practices of single and multiple stem pruning. This is a monoclonal block.

Banana trash as mulch has proved to be effective in increasing coffee yields but its production involves hand labour. With a view to investigating the possibilities, as mulch, of certain grasses which can be harvested mechanically and are useful fodder grasses, an experiment was superimposed

on Experiment I using Giant Cynodon and Guinea grass as mulch treatments, each at two different levels. The application of farmyard manure was also included as a treatment.

A further six off-Station clonal trials were planted, three of which were on Moshi Native Coffee Board plots and the rest on European owned coffee estates, one at Oldeani and two at Usa River.

The recording of one off-Station experiment at Usa River was commenced.

On Lyamungu Coffee Estate the clearing of Block 17 (about thirty acres) was completed and the whole area was ploughed and cultivated in order to eradicate couch and other undesirable weeds. Block 18 Lyamungu Coffee Estate was planted with grasses, about four acres each of *C. Plectostachyum*, *P. Salifex* and Elephant grass. These grasses were planted with a view to improving the soil structure preparatory to planting coffee in two to three years' time.

Leaf miner has not been quite so serious in 1951 as in 1950. *Antestia* has been kept under control, but White Stem Borer continues to be a serious menace, especially to the lower parts of the Station. The incidence of *Hemeleia vastatrix* has been about normal until the end of the year when it increased considerably on account of the prolonged rains.

The statistical analysis of the yields from the various experiments and trials of selections up to and including 1950 were completed. The results of the experiments and trials of selections up to and including 1950 were completed. The results of the experiments show the same trend as in previous years. The effective treatments are summarised below :—

1. Banana trash as mulch at 40 lb. per tree.
2. Irrigation to the extent of making up the rainfall to two inches monthly.
3. A combination of (1) and (2).
4. Compost at one 4-gallon tin per tree.
5. Pruning on the multiple stem system as compared with single stem system.

In the experiment in which various methods of cultivation have been applied over a period of thirteen years, no conclusive result has been obtained but the results suggest that cultivation with the fork jembe is the best.

Sulphate of ammonia at 3 ozs. per tree and Elephant grass (as mulch) have increased yields when applied singly but the increases are not significant—the depressing effect on yield of combinations of these two treatments and the depressing effect of sulphate of ammonia when applied with compost may, due to the design of the particular experiment, have masked the real effect of the single treatments of sulphate of ammonia and Elephant grass.

The results also show that heavier applications of banana trash and irrigation than those given in (1) and (2) above produce no further increase in yield.

Not the least important of the information obtained from the experiments designed to improve growing conditions is the indication that different clones may respond in differing degrees to the same treatment.

In the clonal selection trials (Experiment XVIII) there are some outstanding trees: KP 423 (L.S. III) on multiple stem has, for its first four bearing years, yielded at the rate of 15.15 cwt. of clean coffee per acre. H66 (L.S.VIII) on single stem, over six bearing years, has yielded at the rate of 11.13 cwt. and N197, in the same square, 11.93 cwt.; both of these latter are grown on the single stem system. In Kents plot the mother tree KP 423 has, over thirteen years, a mean annual yield at the rate of 14 cwt. of clean coffee per acre and there are several which have a mean annual yield of 13 cwt. In Experiment I—Tree No. 1 has a mean annual yield of 17.52 cwt. and four more have exceeded 15 cwt. for a thirteen-year period. Within the seedling progeny plots of H 61 a tree has been found which, over three years, has a mean annual yield at the rate of 25.9 cwt per acre, the yields for the individual years being at the rate of 31.6 cwt., 9.2 cwt. and 36.9 cwt. per acre. Another tree from the same plots has averaged at the rate of 23.3 cwt. per acre for the same period. Although these trees have yielded far in excess of the mean yield for the particular plots it cannot be assumed that the difference is due necessarily to genetical factors; environmental factors may play an important part.

In the experiment (IIIA) where the yields of clones and seedlings of the same mother trees are being compared the summary of results for six years shows that there is no significant difference in yields. In another experiment (III) where a similar comparison is possible and in which yields have been recorded for the eleventh to fourteenth year from planting out, a significant difference in favour of seedlings is shown.

Up to the 1950 season Experiment IIIA had been recorded by plots, in 1950 individual tree yields were recorded, the yields show a coefficient of variation of 63.32 per cent and 58.28 per cent for clones and seedlings respectively, i.e. the variation in yield from tree to tree was slightly greater in clones than seedlings in the 1950 season.

A similar figure for Experiment III for three years shows the coefficient of variation to be 35.39 per cent in the case of seedlings and 39.25 per cent for clones. It seems therefore that the tree to tree variation is of the same order for both clones and seedlings of the same parent trees.

Beans produced by the seedling and clonal progeny of a mother tree when grown under the same set of conditions show no difference in density despite differences in weight and volume. Differences do occur in density between the beans produced by different mother trees.

Vegetative Propagation.—17,236 cuttings were taken during the year, of these, 13,152 had rooted by the end of December. Losses after rooting were still further reduced.

The normal entire softwood cuttings proved superior to single node cuttings, both basal and medial, and to soft tips having two pairs of leaves only.

Alpha-naphthalene-acetic acid applied by means of the concentrated dip method, hastened rooting, a strength of 1,000 p.p.m. proved quicker than weaker strengths. There was no significant difference in the number of cuttings rooted. It is interesting to note that there was, in this experiment, a highly significant negative correlation between the time taken to root and the average number of roots per cutting ($r=-0.963$, $p=.01$); the longer the cuttings took to root, the less were the average number of roots per cutting.

Mbosi sub-Station.—Investigational work on the cause of “black” or “wither” tip of coffee in the Mbosi area was continued. Originally it was considered that Boron deficiency might be the cause but the injection and spraying of affected trees with Boron compounds failed to prevent the occurrence. The possibility of the deficiency of other minor elements being the cause is being investigated by the Government Chemist.

The field experiments with phosphatic fertilisers have been maintained.

Animal Husbandry.—Thirty-nine calves were born during the year, twenty-one being heifers.

The total milk production amounted to 6,035 gallons from forty-three cows.

All cows and their progeny that had not produced 200 gallons in any one lactation were culled during the year. The progeny of the Sahiwal-Boran cross bull are doing well, three out of thirteen yielded over 300 gallons in their first lactation, of the remainder only four failed to reach 200 gallons in their first lactation.

There were two cases of “fly” both of which recovered. One cow was lost from milk fever.

F. R. SANDERS,
Senior Research Officer

SISAL RESEARCH STATION, MLINGANO, NGOMENI

PART I

Clearing and Planting Works.—Clearing of derelict rubber and bush is desirable on account of the tsetse fly but in view of a shortage of labour such work can only be undertaken when the other more essential functions of the Station permit. Nevertheless some twenty acres were cleared, mainly in the vicinity of the new houses situated in the centre of the property. Twenty acres of maize were planted and despite depredations by rats a good crop was obtained which provided food for African workers. Four acres in a valley were planted with bananas. Hedges, ornamentals and fruit trees were planted in the gardens of the new houses. Developed areas were kept free of secondary bush growth and roads were maintained and dressed with murrum.

Citrus.—Orders for citrus trees have been exceptionally heavy this year and nearly 9,000 budded trees were despatched to sisal estates and other purchasers in Tanganyika and Kenya. Dependence upon brackish water about the end of 1950 and during the first months of this year resulted in the loss of rough lemon seedlings intended for budding in time to meet possible requirements in 1952. Unfortunately this means that supplies of budded trees will be short next year. The nurseries have been given heavy dressings of cattle manure and 10,000 stocks planted last April are growing well. Minor outbreaks of scab were treated by spraying.

Base Fibre Crops.—Seed of several varieties of Hibiscus, including Kenaf (*H. cannabinus*), received from South Africa through the Department of Agriculture was sown in small test plots. Germination was good but none of the types grew more than four feet high and flowering started at an early stage. Better results might have been obtained if the date of sowing had been earlier coupled with an application of fertilisers. Seed was collected for planting up larger plots next year.

A plot of ramie (*Boehmeria nivea*) was planted on heavily manured land. Growth was slow and the crop was short until October when plentiful rain favoured the development of taller and more succulent stems. Ramie is a gross feeder requiring a rich soil and well distributed rainfall.

Cover Crops.—Plots of *Tephrosia candida*, Tropical Kudzu vine (*Pueraria phaseolides*) and *Centrosema Plumieri* started last year, fared better under the more favourable growing conditions prevailing during 1951. The *T. candida* is providing a tall dense cover but the recumbent types have tended to become smothered with grass and weeds necessitating periodical hand weeding. The tropical Kudzu vine was slow to become established but its roots bear nodules formed by nitrogen-fixing bacteria. Attempts to propagate this plant by cuttings in young sisal failed; more success attended the use of

transplants of *Glycine javanica*, an indigenous legume which provides a neat recumbent cover. These cover crops began to flower this year and seed has been collected for future sowings.

Elephant Grass.—The Station has a large area under elephant grass (*Pennisetum purpureum*) mainly as a fallow crop for restoring the structure and organic matter content of land previously carrying agaves or food crops. A part is set aside to provide fodder for the cattle. Considerable quantities of cuttings were supplied to certain estates for trial.

Weather.—The meteorological station at Mlingano is well equipped with an automatic rain-gauge, anemometer, sunshine recorder, soil thermometers and the usual Stevenson screen.

Nineteen hundred and fifty-one proved to be the wettest year experienced at Mlingano. The total rainfall amounted to 71.81 inches which constitutes a record. During January and February the weather was mainly hot and dry but from mid-March onwards there were several heavy showers culminating in a heavy fall of 4.33 inches in less than two and a half hours on 31st March. The rainy weather continued almost without a break during April and May and was most favourable to all crops. Thereafter frequent showers coupled with cool conditions kept the vegetation fresh but a dry period set in about mid-August lasting until the first week of October. September was the driest month of the year. Timely and unusually heavy and prolonged rains in October revived the growth of the sisal and other crops but the exceptionally wet conditions which lasted well into December interrupted the progress of field work.

Rainfall records for 1951 are given below :—

RAINFALL RECORDS

Month	1951		16 years average	
	Inches	No. of days	Inches	No. of days
January	1.17	9	1.12	4
February	1.22	12	1.39	5
March	4.05	9	4.47	10
April	11.00	17	7.35	17
May	16.82	24	9.49	19
June	1.01	11	2.28	12
July	2.86	13	1.79	12
August	1.55	13	2.36	12
September	0.74	10	3.60	12
October	9.88	17	4.94	11
November	13.64	21	3.98	11
December	7.87	16	3.03	11
Total	71.81	172	45.80	136

As might be expected in a wet year, the hours of sunshine were less than usual. The strongest winds prevailing during the month of January but atmospheric conditions were much calmer in February and the ensuing months. Maximum and minimum screen temperatures varied little from

last year except that they tended to be slightly lower during January and February. Soil temperatures were nearly eight degrees centigrade higher in the hot season than in the cool season.

An exceptionally sharp and severe outbreak of sun-scorch of sisal leaves occurred in November when the weather was hot and humid.

Programme of Experimental Work.—Much of the experimental work carried out by Mlingano to-day is connected with the maintenance of soil fertility and the rectification of deficiency diseases of sisal. This work is proving to be highly interesting especially now that certain of the manurial trials are beginning to show some positive results. It may be claimed that steady progress is being made in these investigations although many years must elapse before a proper understanding of the nutrition of the sisal plant can be gained due to the complexity of the problems confronting the experimentalist as well as to the nature of the crop.

This year has witnessed a considerable expansion in the programme of manurial trials as the Station has put down a number of exploratory manurial trials on outside estates. Each trial is strategically sited on a specific soil type so as to serve as wide an area as possible and in each case the worst piece of land available has been chosen for experimentation. This programme received the approval of the Technical Sub-Committee.

All told the Station is now responsible for conducting thirty-five trials twenty-one of which are on Mlingano and fourteen on various estates. These trials follow the well-known complex and efficient designs evolved by the Statistical Department at the Rothamsted Experimental Station, England, and they involve the recording of over 1,700 separate plots. In the main they are concerned with the cultivation of sisal, spacing, spacing combined with cutting methods, prematurely early cutting and severity of cutting, mulching, ridging, manuring, interplanting, placement of fertilizers, fallowing and grass rotations, testing of agave hybrids and the use of growth promoting substances and insecticides in bulbil nurseries.

Field Trials on the Station.—At the present time some of the most important trials in progress at Mlingano are those sited on land which has been exhausted by growing sisal uninterruptedly over the past sixteen years.

Cultivation Trial.—The cultivation trial dates back to 1936 and is one of the oldest trials on the Station. There are six treatments varying from continuous clean weeding to no weeding. Two-thirds of the sisal is now in its third cycle while the remaining third is still in its second cycle and these variations in growth are a consequence of intensity of weed competition. Since fibre yields per cycle are highly correlated with the number of leaves cut per hectare and this turns upon the number of leaves cut per plant, and since the latter factor depends to a large extent upon the rate of growth particularly during the early stages of the sisal, it follows that the trend of the results during both the first and second cycles is in favour of weeding young sisal. It has been shown already that the rate of unfurling new leaves

is governed mainly by rainfall and the supply of soil moisture and one inference still to be drawn from the data of this experiment is that the principal effect of weeds lies in competition for soil moisture especially during dry periods.

The necessity for weeding young sisal is an inescapable fact if yields are not to be depressed through slow initial growth which is invariably accompanied by high losses of the earliest leaves due to withering. On the other hand the Cultivation trial has become a most convincing demonstration of the terrible dangers of a bare soil under African conditions. The third cycle sisal in the plots which have always been kept clean weeded since 1936 is now most unhealthy (and is suffering from numerous deficiency diseases including banding disease) due to prolonged exposure with the consequence that the surface layer "packs" under beating rain which reduces percolation and is conducive to run-off.

A first cutting of sisal was taken in 1951 when it was thirty-nine months old and the yield compares most unfavourably with those obtained for similar cuttings during the first and second cycles. An example is given in the following table :—

CULTIVATION TRIAL—FIRST CUTTING RESULTS

TREATMENT—CLEAN WEEDING AND DEEP CULTIVATION

Fibre Yield tons/ha.				No. of months from planting	No. of leaves grown/planted	No. of leaves cut per plant
1st cycle	2.64	...	...	29	113	63
2nd cycle	2.13	...	...	33	117	47
3rd cycle	0.85	...	...	39	105	26

An alternative method of cultivating sisal which is being tried at Mlingano at the present time entails weeding near the plants for the first two years or so until they are large enough to withstand weed competition, and leaving a band of vegetation between the rows of sisal which is slashed back two or three times annually prior to the onset of dry weather. The slashings are then available for use as dead mulch alongside the rows of sisal. Under this system the soil always has either a living or dead protective cover and can be kept cool and moist. Organic matter present on the surface layer keeps the soil in a permeable condition while soil wash is minimised. It is here that the widely spaced double-row method of planting comes into its own compared with single-row spacing.

The cover crop (*Glycine javanica*) plots in this trial are now carrying third-cycle young sisal which is far from satisfactory. Banding disease has developed in some of the plots and the growth of the cover crop is partly attributable to impoverishment of the soil. It may be reiterated that attempts to establish leguminous cover crops in single row sisal have never been conspicuously successful.

Second cycle sisal growing in competition with grasses (the dominant species being *Panicum trichocladum*) and weeds which are cutlassed periodically is seven years old and fairly heavy poling is taking place. The

sisal is large and healthy but the yield of fibre obtained to date is only 5.33 tons per hectare largely owing to slow growth during the first years of the sisal.

Unweeded sisal in its second cycle is four and a half years old but has not been cut yet. The leaves are flaccid and light due to shading effects. The soil, however is a darker colour than in the weeded plots and it has retained its structure.

Spacing Trial.—This trial compares yields from eight different plant populations varying from 1,666 to 10,000 plants per hectare. First cycle results showed a high and positive correlation between plant population and total yields, and likewise with the duration of the life cycle of the sisal. Full results for the second cycle are not yet to hand but four of the treatments which have 4,166 plants/Ha. or less have poled out and are now in their third cycle. The aggregate yields obtained over the past fifteen years do not vary greatly with plant populations of 5,000/Ha. or more. Deficiency symptoms are noticeable in the 10,000/Ha. plots and also in the low density plots. In the latter case soil deterioration may not be due entirely to continuous cropping with sisal; in part it may be brought about by the necessity for preparing the soil and replanting at fairly frequent intervals. This has led to restriction of weed growth and a bare soil.

Spacing × Cutting Trials.—The original spacing × cutting trial was planted in 1949. As it is over two and a half years old, plots due at two years and two and a half years have been cut for the first time. The sisal is rather irregular on account of weevil attack and much of it has incipient symptoms of purple leaf tip roll. First cycle results showed that plant population and the stage when cutting commences are the most important factors affecting yields. Distances between the rows, whether single or double rows, and cutting cycles did not have a significant effect upon yields. Late commencement of cutting combined with a low plant population resulted in early poling and less crop.

The severity of cutting trial, started in 1947 on virgin land, contains some large sisal. The treatments comprise cutting at one and a half, two and two and a half years from planting, leaving eight, sixteen and twenty-four leaves per plant at cutting cycles of six, nine and twelve months. These twenty-seven different cutting systems are imposed on plots having 4,000, 5,000 and 6,000 plants per Ha. all spaced in double-rows. At the time of writing heavy poling has occurred in the low density plots which have been cut leniently. High density sisal which has been cut severely and frequently since it was eighteen months old is markedly dwarfed although the leaves are just over three feet long. It is not yet possible to judge the effects of treatment upon fibre yields.

A new spacing and cutting experiment, designed primarily to study the effects of trimming the very earliest or "sand" leaves was planted this year. The transplants were sprayed by Messrs. Pest Control Limited and losses through the weevil damage have not been excessive and the sisal is growing satisfactorily.

Uncut plants in the Fibre Characteristics trial which are four and a half years old have produced thick massive poles having flowering branches from almost every bract on the pole. Plants cut severely and frequently since they reach the thirtieth leaf stage continue to be extremely puny.

The check given to the sisal through excessive trimming of the leaves of transplants when they were lifted from the nursery nearly four years ago can still be seen in the Planting Methods trial. This is equivalent to a cutting or defoliation effect. Trimming roots and depth of planting have not had any material effect upon the subsequent development of the plants.

Fertility Trial.—This long-term experiment is sited on land which has only carried one cycle of sisal. Twelve different rotational systems are undergoing test and the value of any one will not be known until the yields of the second cycle are available. Young sisal which is kept clean weeded by disc-harrowing (after sisal treated in the same way during the first cycle) is growing quite well although it possibly lacks the "bloom" associated with young sisal on virgin land. It differs little from that interplanted with a leguminous cover crop which is following a similar treatment during the first cycle and this provides further confirmation that vegetal strips between double-row sisal do not compete with the sisal itself. In another treatment the cover crop is replaced by a strip itself. In another treatment the cover crop is replaced by a strip of grass (*Panicum trichocladum*) which is cutlashed regularly so as to provide material for mulching the sisal. The sisal compares well with that kept clean weeded. Good rains have encouraged growth in the elephant grass plots resulting in bulky quantities of trash for mulching the land but the grass is growing less luxuriantly except in plots treated with nitrogenous and phosphatic fertilizers. Plant residues from the previous sisal crop have rotted down and are in a suitable condition for incorporation into the soil. Plots of *Tephrosia candida* are tall and bushy thereby giving effective shade to the soil but fall has been relatively light compared with an elephant grass mulch while the root system of this leguminous plant does not appear to assist in the formation of soil crumbs. Natural vegetation plots are carrying a knee-high stand of grass plus light bush growth. Green manuring with sunn hemp (*Crotalaria juncea*) has not proved very successful; repeated ploughing is progressively leading to a break down of soil structure and there is every indication at present that this system cannot be recommended.

Grass Rotational Trial.—An important feature of this experiment is that it is sited on sisal-exhausted land. The main treatments are elephant grass and guinea grass leys and sisal all three of which have received dressings of lime, nitrogen, phosphate and potash in every combination. Half the grass plots are grazed by cattle while the other half are cutlashed periodically. Owing to plentiful rains the grasses have done well especially on plots receiving nitrogenous and phosphatic dressings but the elephant grass has not withstood grazing as well as the guinea grass. Weevil damage has resulted in an irregular and gappy stand of sisal but small responses to

the fertilizers are becoming apparent. The grass plots will be ploughed up and replanted with sisal next year.

Factorial Manurial Trial.—This complex experiment is also planted on exhausted land. The sisal is nearly two and a half years old and cutting of the most forward plots began in August. In order to avoid cutting effects, cutting of each plot begins when the average number of leaves produced per plant lies between 90-100. So far 50 of the 81 plots have been cut giving fibre yields ranging between 0.73 to 1.81 tons per ha. The treatments comprise dressings of lime, nitrogen, phosphate and potash in every combination and each at three levels—none, moderate and heavy rates, all but the lime being applied annually.

There are now visible and striking differences between the various plots. Lack of nitrogen in the presence of lime and phosphate or both often leads to the leaves having a pale uniform shade of green. Excess nitrogen in the absence of lime or phosphate, sometimes coupled with too much potash, has resulted in pronounced chlorotic mottling of the leaves, a symptom believed to be connected with a shortage of calcium. In some plots the symptoms are so acute that longitudinal lesions have developed in the region of leaf tips. Lime and phosphate have generally brought about an improvement in the colour of the sisal providing the supplies of nitrogen and potash are in balance. Purple leaf tip roll is not entirely absent in all the plots although it is least evident in the treatments which include nitrogen and phosphate.

Analysis of the treatments which have been cut to date suggests that nitrogen has some role in hastening the growth of sisal since none of the plots where nitrogen is absent is ready for cutting yet. Lime and phosphate have also assisted in stimulating growth but potash does not appear to have had much influence in this direction.

Careful and elaborate records are taken at every cutting since it is hoped to determine those factors which affect the development of fibre within the leaf besides others which are essential for the nutrition of the plant. For the present it can only be assumed that the healthiest sisal, if cut correctly, will give the best fibre yields although possibilities of "Luxury" consumption of plant foods cannot be ignored entirely.

Fertilizer Placement Trial.—In this experiment nitrogenous and phosphatic fertilizers have each been placed as follows (i) on the rows of sisal, (ii) on the grass cover strips, and (iii) broad-casted. In spite of the sisal being irregular because of weevil damage small differences in the appearance of plots are becoming noticeable. Current analyses of growth records indicate that it is best to place fertilizers on the rows of sisal. Fertilizer effects on the grass strip may also be observed.

Mulching Trial.—The sisal in this trial is two and half years old and it is not very good for its age. The land has carried sisal continuously since 1936. A first cutting was taken in October and there were significant responses

to all the mulching treatments except cotton seed. The difference between coconut cake and an elephant grass mulch was not significant. Old sisal waste applied annually at the rate of fifty tons/ha. had the greatest effect upon yields. Unfortunately the precision of this experiment has been marred by variable soil conditions and the results are not as conclusive as could be desired.

Ridging Trial.—Ridged sisal has yielded 3.76 tons to date over two cuttings compared with 2.60 tons per ha. for that planted on the flat. Although the plant population is 6000/ha. the sisal is quite massive. The ridged sisal has grown slightly faster and therefore may pole sooner than that on the flat. Light post-cutting applications of fertilizers have not influenced yields so far.

Interplanting Trial.—During the first two years maize, sorghums, and beans, each fertilized and unfertilized, were planted between the single and double rows of sisal in this trial. The food crops suffered from drought in 1949 but fared better in 1950. This year depredations by rats defeated several attempts to establish the maize and sorghum. It has thus eventuated that the young sisal has not been subjected to severe competition from the food crops, nevertheless the results of a first cutting show that sorghum had a highly significant depressing effect upon fibre yields. Much of this is traceable to the droughty period in 1949 when the young plants wilted. Maize also depressed fibre yields but the difference did not quite reach the required level of significance. Beans had no appreciable effect upon the sisal while differences between single-row and double-row sisal were negligible. Applications of fertilizers to the food crops have made no difference to the sisal.

It seems that young sisal suffers least from competition by interplanted food crops whenever the rainfall is adequate or else the soil is fertile and has good moisture holding properties. Frequent weeding of the intercrops may be regarded as a disadvantage because it is conducive to over clean conditions.

Bulbil Nursery Manurial Trial.—The second nursery on the same site was lifted during the year and the plants were weighed. Once again the results showed that wide spacing (50 × 25 cms.) was superior to narrow spacing (30 × 25 cms.). Nitrogenous and phosphatic fertilizers had no effect upon growth but there were marked responses to fresh sisal waste and old sisal waste, each applied at a rate of fifty tons per ha. The size of the plants was almost doubled when both forms of waste were applied together. Losses due to weevil were very small.

Agave Hybrid Comparative Trials.—These trials are progressing satisfactorily and certain hybrids will be ready for cutting next year. Bulbils of other selections were planted in nurseries.

External Trials.—The two spacing × cutting trials situated in the Kilosa and Morogoro districts respectively were started in 1944 but there is every

indication that they will last until 1952 or longer. At Kilosa the 4000/Ha. and 5000 Ha. density plots have poled heavily especially when commencement of cutting was deferred to three years. The 6000/Ha. plots are still in bearing and the plants have not been dwarfed excessively through early cutting. Fibre yields have been most satisfactory. The trial in the Morogoro district has grown more slowly. The sisal is short and yellowish largely due to difficulties in establishing a soil cover after two years of clean weeding. The results of these experiments tend to conform with those obtained from a similar trial at Mlingano.

The grass rotational manurial trial on a sandy soil in the coastal belt near Tanga has been maintained during the year. The grasses are now well established but their effect upon soil fertility cannot be ascertained until next year when the entire areas will have been replanted with sisal. The grasses responded to dressings of nitrogen and phosphate.

A ridging x manurial trial sited on a water-logged calcareous black clay near Pangani has suffered considerably from weevil attack. Ridging brought about a great improvement in the condition of the sisal while banding disease was rectified by applying potash.

The Station has put down five exploratory manurial trials in different parts of the Tanga Province. One is on a loose red coastal sandy soil and another is on a red earth derived from coral rock. Further inland a trial has been sited on a poor brownish grey sand having a yellowish sandy clay subsoil. Two more trials on red soils are situated in the Korogwe and Same districts. Despite using selected planting material raised at Mlingano, the establishment of some of these trials has not been easy owing to heavy losses from weevil attack. Two of the coastal trials were uprooted and replanted later in the year and all three have been treated with insecticides by the staff of Messrs. Pest Control Limited. Moles destroyed several plants in an up-country experiment. Each trial is planted on old sisal land.

In addition a grass rotational and manurial trial as well as a factorial manurial trial were started on an estate in the Korogwe district. Here the soil has been denuded of its fertility through fairly prolonged sisal growing but more especially through loss of topsoil caused by bulldozing. The growth of the grasses has not been as spectacular as in similar trials elsewhere but it may improve in the course of time. The new sisal is spindly and has not yet shown any response to fertilizers.

Two fertilizer demonstration plots were also put down on estate sisal in the Korogwe district.

The "banding disease" manurial trial which has been running since 1947 on an estate having a dark-brown clay-loam in the Tanga district was cut for the third time this year. Plots treated with potash have yielded 7.02 tons to date compared with 4.57 tons per ha. for those not given potash. The difference of 2.45 tons/Ha. is highly significant and represents the overall response to cumulative applications amounting to 800 lb. of

Sulphate of Potash per ha. The cost of such manuring works out at Shs. 270/- per ha. and this expenditure appears to be fully justified by the returns obtained. The effects of nitrogen-phosphate were not significant.

Plant Physiology.—On return from home leave, the main line of research has been concerned with the Factorial Manurial Trial. Other work undertaken has dealt with the sand culture of sisal, injection techniques on sisal plants showing mineral deficiency symptoms, the trial of growth-promoting substances for root stimulation, preliminary work on the transpiration of sisal plants, and studies on the growth of isolated leaves in nutrient solution and dissected out growing points on a nutrient agar medium.

Bole Rot Investigation.—Further work was carried out during the dry season with the inoculation of freshly cut leaf bases with a pure culture of the fungus *Aspergillus niger* previously prepared by Mrs. M. M. Wallace of the Plant Pathology Laboratory, Lyamungu. Once again differences due to severity of cutting and the site of inoculation were not significant but a significantly high proportion (78 per cent) of the infected plants have succumbed to bole rot. No rotting occurred in the control plots. Inoculations were made in March but the plants did not lose colour and wilt until six months later.

Entomology.—Apart from planting one trial for insecticide tests no work was done under this heading since Messrs. Pest Control Limited are undertaking a study of the sisal weevil and suitable control measures.

Fibre Testing.—Fibre testing work was confined to determining the fineness of fibres from single leaf samples taken from the Fibre Characteristics and the Factorial Manurial Trials.

Livestock.—A grade Ayrshire bull was purchased during the year. Eighteen calves were born, one died and seven beasts were killed for meat. Extension to the fly-proof byre include milking stalls, calf-pens and a calving box and these have provided more commodious accommodation for the small Zebu herd maintained on the Station. Twelve male animals which have been grazing out of doors since November, 1950 have kept healthy.

Planters' Day.—Planters' Day was held on 2nd August and was attended by 187 visitors who were shown round the field trials. They also witnessed demonstrations of the Marden Bush Breaker and the Marden Grass Cutter which were kindly arranged by Messrs. International Motor Mart, Limited. A large tractor was lent for the occasion by Messrs. Consolidated Sisal Estates of East Africa, Limited. Comprehensive exhibits composed of diagrams, models and specimens prepared by the staff were displayed in two of the new laboratories.

The Station was open to African employees from sisal estates on the following day and the event proved a great success.

Publication and Reports.—Two half-yearly reports were submitted to the Research and Mlingano Managements Committee which were circulated to all growers by the Tanganyika Sisal Growers' Association. Three

research bulletins prepared during the previous year were printed and a third report on "A Preliminary Survey of Sisal Diseases in Tanganyika Territory", by Dr. I. A. Black, of the East African Agriculture and Forestry Research Organization is now in the press. Three more articles on various aspects of sisal cultivation and research have not yet been published. Other reports written by the staff during the year include a review of sisal cultivation in Tanganyika, a synopsis of overseas research, a memorandum on spectrographic methods of analysis, and one on sisal research in East Africa. There was no diminution in the amount of advisory correspondence dealt with during the year.

Malarial Control.—The Station is assisted by the Malarial Research Unit, Amani, in the application of control measures against malaria. Trees of *Lagerstroemia speciosa* planted near the edge of the dam have been partly submerged since last May. Leaf fall was greater compared with those planted on higher ground but the trees have so far withstood prolonged flooding.

Department of Agriculture and E.A.A.F.R.O.—The Department of Agriculture assisted through the secondment of four Senior Service and seven Junior Service officers to the Station. Besides handling Crown Agents indents, seed and copies of scientific papers were supplied.

The Station continued to keep close contact with the East African Agriculture and Forestry Research Organization and, as reported earlier, received considerable advice and assistance in various directions such as the layout and statistical analysis of trials, soil and plant analytical methods, soil analyses, botanical identifications and planting material. The organization has the use of a plot of land at Mlingano for testing cassava hybrids for resistance against mosaic and brown streak virus diseases. The Fertilizer Experiments Team repeated one manurial trial with maize on the Station.

The Government Chemist, Dar es Salaam, kindly helped by carrying out soil and fertilizer analyses.

Acknowledgments.—The Station wishes to record its indebtedness to Messrs. Noorani Plantations, Limited, for their co-operation in providing decorticating facilities at Ngomeni Estate whenever required as well as assisting in other ways. The ready help given by many other estates, particularly in connection with external trials, is also gratefully acknowledged.

G. W. LOCK,
Senior Research Officer

PROGRESS REPORT OF THE EMPIRE COTTON GROWING CORPORATION, UKIRIGURU, FOR THE SEASON 1950-51

COTTON—UKIRIGURU

Planting : 29th November to 27th January.

Picking : May to September.

Legal Uprooting date : 17th September.

Rainfall for the period 1st October to 30th June : 33.39 inches.

Meteorology.—The rainfall for the season was satisfactory. A week of good rain at the end of October allowed an early start to be made with land preparation; November was dry. From early December there was an even distribution until the end of April.

GENERAL INTRODUCTION

Climatically the season was a good one. But cotton planting was generally late to very late, and labour for cultivation was scarce and difficult for a number of reasons, at planting time, the people of the Province were unsettled. In many areas the returns from hedge-row sisal had been substantial—figures up to Shs. 10/- per day for a family have been mentioned. In the hands of people not used to it, such money was unsettling. The people with their simple wants satisfied temporarily, were disinclined to start the labour of hand cultivation for the new season. To the south of the Province the pattern of field practices seemed to get behind. The previous season's sorghum crop had been a heavy one; the people had to complete the movement of their crop, and get the next sorghum crop planted before they turned to cotton planting.

As was forecast in last season's report, the acreage of timely planted cotton was much below the normal. But fair acreages were planted later in January, in February, and even into March. Yields from the later planted cotton were considerably lower than from the earlier plantings. The provincial crop of just over 40,000 bales therefore—higher than the early forecasts—must be considered quite reasonable. With timely planting an appreciably larger crop should have resulted.

Uk.46 was in cultivation throughout the Province, with exception of the Shinyanga district (ginning difficulties prevented seed being available in time to cover the whole Province). Uk.46 in general bulk cultivation cropped well through to the end of the season. This may have contributed in part to the final crop realized. Uk.46, in commercial ginning gave, compared to Mz.561, more than the 1.5 per cent increase in ginning percentage which experimental results had indicated.

The Lake Province Cotton Committee, shortly it is hoped to be regularized under the Cotton Lint and Seed Marketing Ordinance, continues active operations. But time is necessary before noticeable practical benefits can be expected to appear as a result of its work. Especially is this so with the mechanization. Much of this is experimental; testing equipment and maintenance problems, the reactions of the people to mechanization, and the effects on their land tenure customs. Most cotton in the Lake Province is grown on ridges in the lighter land areas. After many difficulties, equipment for such ridging, obtained from the United States, should soon be available.

At Ukiriguru—and at Lubaga—the shortages of manual labour have made it a very difficult year indeed. Only the International Harvester tractor and the ridging equipment allowed of sufficient land preparation for a reasonable planting programme. But there were serious delays in weeding; picking was protracted; and bird loss was heavy on the bulrush millet before harvesting of that was possible.

Hill ridged land is difficult to keep clean except by hand labour; inter-row cultivation is impeded by the big ties. With hand ridging the dry season growth is pulled into the old furrow and the new ridge then built over it. With mechanical ridge-breaking and building, there is greater dispersal of weeds and therefore more insistent problems of weeding through the growing season.

The laboratory-office block, ginnery store, and quarters, at Ukiriguru have been completed and are in use. Further land development has been held up by the shortage of labour; and in fact the maintenance work on land and roads throughout the year has been quite insufficient.

1951-52 Cotton Planting.—Hedge-row sisal prices have been lower than a year ago, and in this market there have been disappointments to the peasant. As against this the cotton price for the new season has been raised to fifty cents per lb. seed cotton. And there have been good—though for some areas and soil types, excessive—early rains. As a result a large cotton acreage has been planted satisfactorily early. There is promise therefore of a substantially increased crop for the Lake Province this coming season.

The Overseas Food Corporation Areas.—Visits were paid by Mr. Bebbington and the senior writer, in March and July, to the Overseas Food Corporation areas at Urambo, Kongwa and Nachingwea. Experimental plantings of cotton had been made in each region. Especially at Urambo and Kongwa, *Callidea* and *Dysdercus* attack make it unlikely that cotton can be grown successfully. At Nachingwea, in the Southern Province, severe American bollworm loss, followed by *Dysdercus* attack, very much reduced yields. This 1951-52 season the E.C.G.C. are guiding the technical approach to cotton experimentation at Nachingwea, and an Overseas Food Corporation entomologist, Mr. J. B. Ward, has been placed under E.C.G.C. technical direction to this end.

SUMMARY OF THE MAIN EXPERIMENTAL RESULTS

The effect of a three years' "Tumbledown" fallow—broken up for 1948-49 season, and therefore in the third year of the cropping cycle—was significantly greater than that of a similar fallow which had been planted with local grasses and legumes.

Responses to three years' rest under resting variants were still evident in experiments in the third, fifth, and seventh years of cropping.

Residual responses from single applications of organic manure have been significant so far up to the seventh season from application. Responses from superphosphate are recorded as lasting at least for three seasons from application.

The value of applying nitrogen to cotton as a top dressing at flowering time, is confirmed.

Good tied-ridges have given small increases in yield, significant in the case of bulrush millet, over poor ridges not tied: the residual benefit of compost has been greater with tied ridges. At Lubaga this year, results from ridged cultivation compared to flat cultivation were inconclusive.

A new seed issue, Uk.51, was constituted. The results of yield trials show satisfactory progress with selected material. A hybridizing programme has been started to add resistance to bacterial blight to the Ukiriguru strains, and to improve the jassid resistance of some of them.

GENERAL ACCOUNT OF THE WORK FOR THE SEASON

Husbandry

In earlier years there was difficulty in interpreting some of the Ukiriguru husbandry results. The results of this past season help to clarify the picture. (Discussions with Dr. A. H. Bunting, lately Chief Scientific Officer of the Overseas Food Corporation, and simple preliminary analyses arranged by him, have been much appreciated). It is hoped that shortly a soil chemist, as part of his activities, may be available to follow up aspects of the Ukiriguru husbandry work.

It would appear that phosphate plays a large part in many of the benefits being obtained, and that the availability of nitrogen to the plant under differing treatments is also of high importance. From simple analyses it seems likely that phosphate is one of the dominant factors in the long continuing responses to organic dressings. Partly as a result of treatment delays due to shortages of labour, there has been little information from Lubaga husbandry experiments or from Ukiriguru experiments on "mbuga" treatment: nor have "mbuga" experiments been possible for this 1951-1952 season.

Land Resting.—The four resting crop trials at Ukiriguru, on hill-sand, discussed in earlier reports. Trials 1, 2, 3 and 4, were under bulrush millet; two this past season were carrying the seventh indicator crop, and two the fifth indicator crop, since the resting crops were dug in. The bulrush

millet could not be harvested in time, and there was considerable loss of grain from birds. Weights of heads without grain were used as some measure of the responses. In one of the two trials started in 1941-42 there were significant responses to some of the resting treatments, in this the seventh season after the digging in of the resting variants: the second trial did not show significant responses. Both the trials started in 1943-44 showed significant responses to treatments dug in five seasons previously. The suggestion made—which of course has to be followed up—is that phosphate may have been made available by these resting treatments.

In Table I are given the yields, second, residual responses, from a combined Resting Crop and Manurial Trial, Trial (6). The second residual responses from compost and from single super-phosphate are good; but the interesting response is from the "tumbledown" fallow variant, three seasons away from the breaking up. For the first crop of the cropping cycle, yields on these plots were depressed—1949-50 Report, Table 2. In the second year they gave the top yields of the experiment, and similarly this past season. In both seasons the yields from the "tumbledown" fallow plots were significantly greater than those following the planted grass fallow. The planted grass plots gave fair grazing; the cover on the "tumbledown" plots was largely *Tridax repens*. Though both variants were grazed, more would have been removed from the planted grass plots, as the grazing was better; oxen have to be removed at nights to bomas.

In weeding experiments, to be mentioned later, there was, in certain of the delayed weeding plots, a heavy growth of *Tridax repens* which smothered the struggling cotton. Dr. A. H. Bunting on a visit suggested that *Tridax* might be a very efficient obtainer of phosphate, much more so than the crop plants. A sampling in some of the plots showed around 1,000 lb. of air dried *Tridax*, tops and roots, per acre, which on analysis was equivalent in P to a fair dressing of single super-phosphate. A following up is essential, but it is possible that at least a part of the "tumbledown" fallow story, which so far has been difficult to interpret, may be in fact largely a phosphate story.

Manuring and Fertilizers.—The substantial benefits from applications of organic manure on Ukiriguru hill-sand have continued. Trial (8), which was manured in the 1944-45 season, still shows most striking residual effects in this the seventh season (Table 2). (F.Y.M. is made under cover and compost in open "bomas" where the cattle are herded at night; a higher proportion of stover and crop residues are trampled in to the compost).

The enhanced residual benefits from organic manure as a result of ridge tying are again indicated by the second residual responses in Trial (15), Table 3; cf. Table 4, 1949-50 report.

The results of Trial (9), Table 4, compared the effects of organic and inorganic manures on hill-sand. This trial was started in the 1947/48 season as an NPK trial, with the nitrogen and control plots split into a

3 × 2 factorial arrangement of P and K. The potash gave no response, and the soda-phosphate was much less effective than superphosphate has proved to be in later trials.

This season a further manurial treatment was applied; compost was substituted for potash; and triple superphosphate for soda-phosphate, using the same plot lay-out. The nitrogen and phosphate (P₂) dressings were intended roughly to be equivalent to the amounts applied in the compost treatment.

Composting gave about 100 lb./acre increase in yield of seed cotton; sulphate of ammonia added about 200 lb./acre. There was practically no interaction between them after adjustment for stand.

Triple superphosphate alone, at 90 lb./acre, gave an increase of 200 lb./acre, some of which might be attributed to the residual effect of the previous application of soda-phosphate, three seasons before. In the presence of nitrogen, this P effect is more than doubled, but the interaction is not significant. The plots which had the full dressing of all fertilizers yielded 800 lb./acre more than the control. Yields were adjusted for differences in stand; these were not due to treatments.

The main conclusions to be drawn are that phosphate applied at planting, combined with nitrogen top dressed at flowering time, gives results in the year of application greater than those obtained from compost alone; and that by suitable manuring on this soil type, the yield of cotton can be doubled.

The residual effects of compost and phosphate, in the second and third seasons after application, are shown in Tables 5 and 6. Nitrogen does not persist beyond the year of application. Compost gives higher residual responses than phosphate. In both trials, phosphate in the presence of compost has shown, either only a very small effect, or no effect. There is an indication that an increase in the rate of application of phosphate does not necessarily give a corresponding increase in yields. This had been noted in previous years in Trial (10), but this might have been due there to the fairly high level of fertility at the start of the trial.

The Lake Province Cotton Committee has supplied phosphate, free, in the only form available at the time, super-raw, for application this 1951-52 season to African lands in exhausted hill-sand areas. It is hoped to continue such demonstrations for a number of years. It had been intended also to demonstrate this new season the effects of top dressed sulphate of ammonia on portions of these phosphate dressed lands, but supplies cannot be obtained in time; these applications will have to be postponed until next year.

LAND TREATMENT

Ridging and Tying.—In one trial under cotton there were no yield differences between poorer ridging and good ridging, nor between tied and not tied on either style of ridging. As last season, there was an increase—though this season not significant—in the residual manurial response in the tied plots compared to the not tied, Table 3.

In a second trial, in the cotton section, at a good yield level for land which had not been manured for several years—control 972 lb. per acre—the seven per cent increase, good ridges tied compared to poor ridges not tied, was not significant. But in the bulrush millet section of the trial, a fourteen per cent increase in favour of the good ridges tied was significant.

Weed-Control.—In a time-of-weeding trial cotton could not be planted until mid-January. In spite of this, plots that were weeded early and then kept clean, yielded over 900 lb. seed cotton per acre; the land was in good heart. Plots, where weed growth was allowed to develop after a first early weeding, yielded only around 100 lb. per acre. A marked delay before starting the first weeding reduced yields to the same sort of level. Plots where *Tridax repens* was not checked also yielded very poorly. The top yields were from plots weeded early and then getting normal weeding.

Time of Planting.—All observations favour early cotton planting. This for the Lake Province entails planting before late December. The importance of this is now appreciated by the authorities, and by many of the cultivators. The need for early planting was approved by the Sukumaland Federal Council. It is not unlikely, from observations on plant appearance, that the poorer growth and cropping resulting from delayed planting, is linked to the leaching of accumulated soil nitrates following early heavy rains. The first plantings probably benefit from such nitrate accumulations.

Rotation.—In the rotation experiment this year no benefits were measured from rotating cotton and bulrush millet, compared to continuous planting of these crops.

COTTON BREEDING

It was a season when jassid damage was slight, and therefore the benefits from jassid resistance were not generally apparent; but in bulk growing in the Province the jassid resistance of Uk.46 showed up. Bacterial blight caused considerable loss. It cannot be claimed that there is any worth-while resistance to bacterial blight in any of the Ukiriguru material, and this in spite of the fact that B₂ B₂ can be got out of most strains. In earlier reports the hope had been expressed that variations in the degree of resistance were showing up. But under conditions favourable to the spread of bacterial blight, whatever resistance there may be is not enough. The adding of bacterial blight resistance to the main Ukiriguru strains is now a major part of the cotton breeding programme. The jassid resistance of Uk.46 and Uk.48 is probably sufficient for most situations; the resistance of Uk.48 is better than Uk.46. The newly-issued Uk.51 is probably even slightly better. But to be safe, higher jassid resistance has to be added to a number of the better Ukiriguru lots, as well as bacterial blight resistance.

The best strains now being worked with are from the 4/86, 5/57, 6/29, 6/318, 6/320, 6/322 families. These have been mentioned in earlier reports.

From 5/57 have come vigorous strains, with good jassid resistance, good spinning qualities, and good ginning percentages, but slightly woody and

late: this affects their cropping in some years. 6/318, very free fruiting, would probably be one of the best Ukiriguru families, if it had better jassid resistance; this is to be added. From 6/320 have come two of the best of the more recent strains, 8/290 and 7/278. 8/290 is especially heavy cropping, but the heavy seed weight results in lower ginning percentages. In district plots, 8/290 was the top yielder (seed cotton) in seven out of twelve trials (trials of twenty-five strains), and it cropped outstandingly well at Ukiriguru and at Lubaga. Yield results from 1951 trials are given in Tables 7, 8 and 9. The yields show how the breeding work is progressing even without bacterial blight resistance; and bacterial blight loss this year was quite appreciable. Given resistance there should be a big advance.

Strains of 7/150 ex 3/28 are being used as the parents in the adding of higher jassid resistance, and Albar 49 from Dr. J. B. Hutchinson has been used up to the present in the bacterial blight resistance hybridizing programme. Some crossing with Stoneville 20 has also been done. But the new selections from Albar 51 from Namulonge are so very much better than Albar 49 that a new hybridizing programme, employing these, will have to be started. They are better cropping, have fuzzy seeds, good lint qualities, and reasonable ginning percentages. As parents they will be incomparably better than Albar 49 which was naked-seeded, with harshlint, and a low ginning percentage. Using the new Albar 51 lots should reduce the period of backcrossing necessary to get acceptable lint and cropping, with resistance to bacterial blight.

Uk.46 this season has cropped reasonably; for 1951-52 it covers the whole Province. With jassid damage unimportant there could be little benefit from its quality of jassid resistance.

In earlier reports it had been suggested that the improvement in ginning percentage Uk.46; Mz.561 was somewhere around 1.5 per cent. A mean of the ginning percentages from trials—Ukiriguru, Lubaga, and from twelve district plots, (Optimum percentages through a twelve-inch roller-gin)—shows 34.4 per cent for Mz.561, compared to 36.3 per cent for Uk.46 and 36.8 per cent for Uk.48—improvements of +1.9 per cent, and +2.4 per cent. (There have been considerable ginning percentage variations from soil type to soil type and from area to area. Seed weight variations are mainly responsible for these differences).

Uk.48, for 1951-52, covers one ginnery zone in Geita district. It has again shown up as a worth-while improvement on Uk.46. One interesting feature is that the yield increases over Mz.561 show up as considerably better on impoverished soil, than on manured land, Table 7.

An Uk.51 was constituted, and issued for first multiplication by eighty growers in Kome Island. It was constituted from strains from the 5/57, 6/29, 6/320, 6/322 and 7/150 families.

Spinning results obtained since the last report was written, for which we are as in other years indebted to the Shirley Institute, continue to show

Uk.46 and Uk.48 as generally similar in spinning qualities to Mz.561. But there are, from time to time, reports of improvement in A.R. Mza grade. These new seed issues, not suffering from jassid attack may be contributing to this better grade.

PESTS AND DISEASES

Pest damage was slight, the loss caused was on the whole unimportant compared to the damage by bacterial blight, (*Xanthomonas malvacearum*).

On Ukiriguru, jassid attack was slight, and the same could be said of most areas. In some areas the jassid resistance of Uk.46 showed up late in the season.

There was very little American bollworm at Ukiriguru and little in the Province as a whole. The planting of early maize—before mid-January—had been discouraged by the authorities.

Stainer damage was lighter than usual, especially towards the south of the Province where stainers can cause considerable loss. At Ukiriguru, and in many of the district plots the percentage of Grade "C" cotton was under ten per cent—in the best five district plots averaging only two and a half per cent. At Lubaga the percentage of Grade "C" was twenty-four per cent; from five district plots to the south of the Province the percentage averaged nine per cent.

The rainfall distribution was such that there was no aph's build-up.

Lygus damage and *Helopeltis* damage were seen on very late-planted cotton in the Geita district.

In the three Overseas Food Corporation areas, there was serious pest damage to the cotton being grown experimentally. At Urambo, in the Western Province, severe loss was caused by *Callidea* and *Dysdercus supersticiosus*; and at Kongwa, in the Central Province, by *Callidea* and *Dysdercus fasciatus*. At Nachingwea, in the Southern Province, there was American bollworm loss—up to very severe loss—and damage by *Dysdercus intermedius*, and to a lesser extent by *Dysdercus fasciatus*, *Dysdercus supersticiosus*, and *Dysdercus cardinalis*. There was no *Callidea* damage at Nachingwea. The cotton at Kongwa and at Nachingwea was comparatively late-planted.

No Red bollworm (*Diparopsis castanea*) was found on Nachingwea cotton, but reasonable numbers were found in native cotton on the south side of the quarantine area, beyond Masasi. The *Gossypioides kirkii* form of *Diparopsis* was found freely in thickets of *Gossypioides kirkii* towards Newala. Dr. C. Evans, Senior Entomologist of the Overseas Food Corporation, is breeding out specimens of the cotton *Diparopsis castanea* form, and the *Gossypioides kirkii* *Diparopsis* form.

Bacterial Blight (*Xanthomonas malvacearum*).—The damage by bacterial blight has been appreciable. It is obvious that work to reduce this loss must be one of the most important parts of the Ukiriguru cotton

programme. A general impression is that the loss suffered is greater under poor growing conditions; stand is reduced by plants being killed off just after the cotyledonary stage. On manured land the plant seems better able partly to grow away from the attack and still crop reasonably well, and post-cotyledonary stand reduction does not seem to be so important.

There is contact with Dr. Wickens's work at Namulonge, and with other work in Uganda. B_2 resistance is quite insufficient. And the conclusion now reached is that whatever the variations in the degree of resistance possessed within the Ukiriguru material these are not of importance if conditions favour the spread of bacterial blight. A strain possessing B_3 seemed to suffer less than B_2 neighbours: and, apart from Albar, BAR 7/8, B_2B_3 , showed the best resistance of the material studied.

Albar 49, grown for the first time at Ukiriguru, was outstanding. Some plants were rogued out for slight vein infection. The remainder seemed to be very highly resistant. Strains nearby in the same field suffered considerably—all from natural infection. No worth-while results were obtained from suspension sprayings. As part of the breeding programme for resistance, work on needle inoculation will be necessary, using *Xanthomonas malvacearum*—following the technique developed by Dr. Wickens, to ensure uniform infection in the separating of resistant and non-resistant segregates.

It is known that the seed of the area is considerably infected. Experiments must be made to test, under Lake Province conditions, what benefit there may be from seed treating. Carry-over trash infection may make seed-treatment not worth-while.

PROGRAMME FOR 1951-52

The programme covers the same general lines as in other years, with development in some sections.

A new twist is given to the cotton breeding work by the hybridizing programme, to add bacterial blight resistance to the main Ukiriguru strains, plus better jassid resistance to some of them. Straight selection and testing continue. It will be worth-while probably to make further seed issues, before the hybrid material is available for bulking.

In the study of resistance segregation, plant inoculation will be necessary using *Xanthomonas malvacearum* inoculum.

The husbandry work continues, with added interest in the effects of phosphate and nitrogen.

J. E. PEAT,
Chief Scientific Officer
(E.C.G.C.),
UKIRIGURU

TABLE 1

Resting Crop and Manurial Trial. Ukiriguru—Hill Sand—Trial (6).
blocks of 5 plots of 1/27.2 acres. 5 foot ridges, 2 rows at 18" spacing, 2 plants per hole.
Planted 14th December, 1950.

Three years Resting Cycle 1945-46 to 1947-48		Three years Cropping Cycle 1948-49 to 1950-51	
Treatments		3rd Indicator crop—Cotton	
		Yield lb. seed cotton per acre	Control=100%
<i>A. Continuous Cropping with bulrush millet, undersown with food legumes</i>			
1. Control—no manure		430	100%
2. 3 tons per acre Compost in 1945-46 and again in 1948-49. Second year residual response to Compost		612	143
3. 400 lb. per acre raw rock phosphate in 1945-46, and 300 lb. per acre single superphosphate in 1948-49. Second year residual response to phosphate		677	158
<i>B. Resting Treatments</i>			
4. 3 years planted grass fallow, undersown Tephrosia and Crotalaria—grazed		541	126
5. 3 years "tumbledown" fallow—grazed		704	164
Sig. Diff. (P=.05)		129	30%
S.E.		+45.1	—

TABLE 2

Manurial Trial. Ukiriguru—Hill sand—Trial (8).
8 blocks of 6 plots of 1/17.8 acres. Planted 14th December, 1950. 5 foot ridges, 2 rows at 18" spacing, 2 plants per hole.

Manurial application made in season 1944-45		Seventh year (sixth residual) responses—1950-51: Indicator Crop Cotton	
		Yield lb. seed cotton per acre	Control=100%
Control—unmanured		360	100%
F.Y.M.—3 tons per acre		457	127
Compost—3 tons per acre		388	108
F.Y.M.—7 tons per acre		540	150
Compost—7 tons per acre		501	139
Cotton seed ash—1½ tons per acre		530	147
Sig. Diff. (P=.05)		104	29%
S.E.		+36.2	—

TABLE 3

Ridging Trial. Ukiriguru—Hill Sand—Trial (15).

2 x 2 x 2 factorial with tie-ridging, height of ridge, and manuring. 4 blocks of 8 plots of 1/29.0 acres. Planted 6th December, 1950. 5 foot ridges, 2 rows at 18 inches spacing, 2 plants per hole.

Treatment										Yield in lb. seed cotton per acre 1950-51	
										No manure	Manured 1948-49 (Compost 5 tons per acre)
Not tied—Control	...	...	...	...	...	...	...	...	...	761	995
Tied	...	...	...	...	...	...	...	...	...	730	1,103
Sig. Diff. (P=0.05)	...	...	...	...	...	...	...	...	...	122	—
S.E.	...	...	...	...	...	...	...	...	...	+41.4	—

TABLE 4

NPD Experiment. Ukiriguru—Hill Sand—Trial (9).

Main plots split to give 3 x 2 factorial, testing all combinations of:—

(Main Plots) no, n1—0, 250 lb. Sulphate of Ammonia per acre.

(Split Plots) do, d1—0, 6 tons Compost per acre. po, p1, p2, —0, 45, 90 lb. Triple Supers per acre.

6 replications of 12 plots, each 1/69.7 acres. Compost and phosphate applied 6—8 December, 1950; planted 13th December, 1950; nitrogen applied 19—20 March, 1951. 5 foot ridges, 2 rows at 18 inches spacing, 2 plants per hole.

Year of Application

Mean Yields	lb. seed cotton per acre (P & D adjusted for stand)											
NO	...	...	...	1,116	...	PO	...	1,218	...	DO	...	1,177
N1	...	...	...	1,510	...	P1	...	1,248	...	D ₁	...	1,443
						P2	...	1,444				
S.E.	...	...	...	±60.0	...		...	±36.2	...		...	±29.6

Interactions

NP	...	...	...	+ 32	...	P ₁ D	...	— 50	...	ND	...	— 13
S.E.	...	...	...	±25.6	...			±25.6	...		...	±20.8

Treatment Yields

	(1)	(D)	N	ND
P ₀ ...	919	1,296	1,092	1,563
P ₁ ...	984	1,209	1,405	1,475
P ₂ ...	1,135	1,405	1,528	1,708
S.E.	P and D treatments ... ± 72.2			

Adjustment for stand—b = 1.505 ± 0.3290

TABLE 5

NPD Experiment—Ukiriguru—Hill Sand—Trial (11).

3 x 3 x 3 experiment in 6 blocks of 9 plots each of 1/48.4 acres (confounding certain 3-term interactions) testing all combinations of:—

no, n_1 , n_2 —0, 125, 250 lb. Sulphate of Ammonia per acre.

po, p_1 , p_2 —0, 45, 90 lb. Triple Supers per acre.

do, d_1 , d_2 —0.3, 6 tons Compost per acre.

Phosphate and Compost applied on 6th December, 1949; nitrogen applied on 27th February, 1950. Planted on 20th December, 1950. 5 foot ridges, 2 rows at 18 inches spacing, 2 plants per hole.

First Residual Year

Mean Yields

lb. seed cotton per acre.

n_0	...	...	855	...	P_0	...	813	...	D_0	...	729
N_1	...	...	888	...	P_1	...	864	...	D_1	...	866
N_2	...	...	818	...	P_2	...	881	...	D_2	...	963

Sig. Diff. 71. S.E. ± 24.4

Interactions

N_2P_2	+ 14	P_2D_2	— 45	N_2D_2	— 9	S.E.	± 21.1
3 x 3 table.		D_0		D_1		D_2	
P_0	...	...	641	...	825	...	974 Sig. Diff. 123
P_1	...	...	754	...	865	...	975 S.E. ± 42.2
P_2	...	...	793	...	908	...	944

TABLE 6

NPKD Experiment—Ukiriguru—Hill Sand—Trial (10).

3 x 3 x 3 x 3 experiment in 9 blocks of 9 plots each of 1/48.4 acres (confounding certain 3- and 4-term interactions) testing all combinations of:—

n_0 , n_1 , n_2 —0, 100, 200 lb. Sulphate of Ammonia per acre.

p_0 , p_1 , p_2 —0, 100, 200 lb. Superphosphate per acre.

k_0 , k_1 , k_2 —0, 50, 100 lb. Sulphate of Potash per acre.

d_0 , d_1 , d_2 —0, 5 (dry), 5 (wet), tons Compost per acre.

Fertilizers applied 12th November, 1948. Planted on 3rd January, 1951. 5 foot ridges, 2 rows at 18 inches spacing, 2 plants per hole.

Second Residual Year

Mean Yields

lb. seed cotton per acre.

N_0	...	1,070	...	P_0	...	1,022	...	K_0	...	1,060	...	P_0	...	933
N_1	...	1,071	...	P_1	...	1,062	...	K_1	...	1,052	...	P_1	...	1,110
N_2	...	1,048	...	P_2	...	1,100	...	K_2	...	1,077	...	D_2	...	1,145

Sig. Diff. 69. S.E. ± 24.3

Interactions

N_2P_2	— 11	N_2K_2	+ 26	N_2D_2	+ 16
P_2D_2	— 37	K_2D_2	+ 4	P_2K_2	— 19
				S.E.	± 22.5

3 x 3 table.

		D_0		D_1		D_2	
P_0	...	...	...	836	...	1,079	...
P_1	...	...	...	983	...	1,092	...
P_2	...	...	...	985	...	1,164	...
						1,168	

Sig. Diff. 128

S.E. ± 44.9

TABLE 7
Mz.561, Uk.46, Uk.48—1951 SEASON
Yield Results—1951 Strain Trials. (for details, see Tables 8 and 9)

	Ukinguru Hill Trial			Ukinguru "mbuga" Trial			Ukinguru (Nyashimba) Trials						Lubaga "Ibushi" Trial		
	Yield seed cotton lb. per acre	Gin-ning %	Lint % of Uk.46	Yield seed cotton lb. per acre	Gin-ning %	Lint % of Uk.46	Yield seed cotton lb. per acre			Gin-ning %			Yield seed cotton lb. per acre	Gin-ning %	Lint % of Uk.46
							A	B	C	D	Mean	A	B	C	D
Mz.561 ...	1,067	33.1	89	1,283	36.1	108	623	573	619	561	34.2	74	86	88	78
Uk.46 ...	1,076	36.7	100	1,150	37.4	100	784	619	660	672	36.6	100	100	100	100
Uk.48 ...	1,083	37.0	101	1,408	35.8	117	825	743	743	726	37.5	108	123	115	111
Sig. Diff. (P = .05)	166	—	16	166	—	14	140	118	129	132	—	18	20	20	20
Standard Error ...	± 59.5	—	—	± 58.1	—	—	± 49.5	± 41.9	± 45.9	± 47.0	—	—	—	—	—

TABLE 8
YIELD RESULTS—1951 STRAIN TRIALS

Family and Strain	Ukiriguru Hill			Ukiriguru "mbuga"			Lubaga "Tbushi"		
	Yield seed cotton lb. per acre	Ginning %	Lint % of U.K.46	Yield seed cotton acre	Ginning %	Lint % of U.K.46	Yield seed cotton lb. per acre	Ginning %	Lint % of U.K.46
U.K.46	1,078	36.7	100	1,150	37.4	100	787	34.0	100
Ex 6/57: 7/7*	987	38.6	96	1,290	40.1	122	794	34.7	102
7/9*	1,118	38.2	108	1,439	38.9	133	915	35.0	120
Mean of 2 later strains ..	1,050	42.1	112	1,343	49.2	132	842	36.9	116
Ex 6/29: 8/64*	1,086	40.6	112	1,397	41.5	135	821	36.8	113
8/71	991	40.0	100	1,279	38.4	119	871	36.4	117
Ex 6/318: 7/253	1,080	35.7	97	1,586	35.1	129	864	33.8	109
7/257	1,075	36.1	97	1,432	37.1	123	885	33.8	111
Ex 6/320: 7/278*	1,218	36.9	114	1,281	37.6	113	881	34.2	113
8/290*	1,196	35.4	107	1,649	34.4	124	1,044	32.9	129
Ex 6/322: 8/333	1,114	35.9	101	1,215	34.4	98	905	34.8	117
8/341*	1,044	35.9	95	1,315	34.8	107	922	34.7	119
Sig. Diff. (P = .05)	166	—	16	166	—	14	105	—	13
Standard Error	± 59.5	—	—	± 58.1	—	—	± 38.0	—	—
<i>Details of Trials:</i>									
Design	7 x 7 Balanced Lattice								
Plot Size	50 x 5 feet								
Planting Date	9th December, 1950								
Spacing	3 foot rows, 18" spacing, 1 plant per hole.								
	4 foot ridges, 18" spacing, 2 plants per hole.								

TABLE 9
MORE RECENT SELECTIONS GROWN UNDER POOR SOIL CONDITIONS
Yield Results—1951 Strain Trials

Family and Strain	Yield seed cotton lb. per acre	Ginning %	Lint % of Uk.46	Ukiriguru (Nya- shimba) Trials
Uk.46	784	36.6	100	Trial A.
Ex 5/57:				
Mean of 4 strains	817	39.4	112	
Uk.46	619	36.6	100	Trial B.
Ex 6/29:				
Mean of 10 strains	759	39.8	133	
Uk.46	660	36.6	100	Trial C.
Ex 7/150:				
Mean of 6 strains	775	38.0	122	
Ex 4/86:				
Mean of 8 strains	763	39.5	125	
Uk.46	672	36.6	100	Trial D.
Ex 6/318:				
Mean of 3 strains	878	37.4	134	
Ex 6/320:				
8/309	875	38.3	136	
Ex 6/322:				
8/338	895	37.0	135	
Standard Error	(See Table 5 for S.E. of yields of single strains)			

Details of Trials:

4 Balanced Lattices (5 x 5) designated A, B, C and D, each with the same standard strains as controls.

Plot Size 25 x 5 foot ridges, 2 rows at 18 inches spacing, 2 plants per hole. Planted 8th January, 1951.

APPENDIX

ORIGIN AND SPECIAL CHARACTERISTICS OF THE MAIN COTTON STRAINS MENTIONED

Lake Province "Local".—The commercial cotton in the Province prior to the issue of Mz.561—mainly of Uganda Local origin.

Mz.561.—A straight selection from "Local", first multiplied in season 1939-40.

Uk.46.—A seed issue with fair Jassid resistance, first multiplied in the 1946-47 season, and now completely replacing Mz.561 as the commercial seed stock of the Province: made up of the four best Ukiriguru strains and the three best Lubaga strains, available at the time.

Uk.48.—A seed issue made up of four strains, 5/57, 6/29, 6/44 and 6/318 of better Jassid resistance than Uk.46. It was first issued for the 1948-49 season, and covers the Buchosa zone in season 1951-52.

- Uk.51.—A seed issue made up of seven strains, with high Jassid resistance; first issued for the 1951-52 season.
- 4/86.—ex 1/45, ex Mz.561, a constituent of Uk.46.
- 5/57.—A derivative of 3/17, itself a straight selection from "Local".
- 6/29.—ex 2/388, itself a derivative of Mz.561.
- 6/44.—A derivative of 3/17, itself a straight selection from "Local".
- 6/318.—ex 4/35, itself a derivative of Mz.561.
- 6/320, 6/322.—ex 4/35, cousin strains to 6/318.
- 7/150.—A derivative of 3/28, itself a selection from Mz.561; of high Jassid resistance.
- "Albar".—A general term for a group of selections from Nigerian Allen. highly resistant to bacterial blight: ex Dr. J. B. Hutchinson.
- Stoneville 20.—An American variety resistant to bacterial blight; ex Namulonge.
- BAR. 7/8.—Blackarm resistant SP. 84 B₂B₃.

ANNUAL REPORT OF THE PLANT PATHOLOGIST, LYAMUNGU, MOSHI, FOR 1951

STAFF

The Plant Pathologist and the Temporary Scientific Assistant (Mrs. M. M. Wallace) were on duty throughout the year. Local leave was taken from 1st to 13th November.

ACKNOWLEDGMENTS

Grateful acknowledgment is made for identifications of fungi, bacteria and viruses by the Director and staff of the Commonwealth Mycological Institute, Kew, Dr. W. J. Dowson and staff of the Botany School, Cambridge, and Dr. K. M. Smith of the Molteno Virus Research Institute, Cambridge. Thanks are also due to the Directors of Agriculture in Zanzibar, Kenya and Uganda for the provision of banana varieties for use in the Wilt susceptibility trials at Moshi.

TOURING

The Plant Pathologist was on tour for sixty-three nights. The Temporary Scientific Assistant visited the Sisal Research Station at Mlingano.

PLANT DISEASES

The most important diseases newly recorded during the year are Pea blight and Banana Wilt or Panama disease. The respective identifications were confirmed by Dr. W. J. Dowson and Dr. S. P. Wiltshire and their assistants. They are referred to below.

Pea, Garden pea and Sweet pea—Bacterial blight (*Pseudomonas pisi*) was found for the first time in Tanganyika in April, 1951. It spread with great rapidity on one farm and in a few gardens, and reduced crops to negligible proportions. Apart from a small localized outbreak at Arusha, which was dealt with, there were no records outside the area west of Moshi until November. In that month the disease was observed at Amani and Lushoto in the Usambara Mountains. From the first observation of the disease intensive efforts were made to prevent spread; infected plants were destroyed by burning or were fed to cattle. It will be necessary in future to apply general routine measures which have been described in the East African Agricultural Journal of July, 1951.

Sweet pea Anthracnose (*Glomerella cingulata*) has been damaging to plants, including the flowers, particularly in wet weather. The disease was described briefly in Mycological Circular No. 31.

Banana.—Wilt or Panama disease (*Fusarium oxysporum* f. *cubense*) was found to be present in native fields east of Moshi in early August, 1951. By the end of the year some ten groups of fields were found affected near Moshi, but no outbreaks outside the Moshi district had been recorded.

The presence of the disease and the measures advised for its control were widely publicized. At first affected trees and their neighbours were taken up, cut into pieces, stacked to dry and be burned. Killing of infected plants by application of heavy gas oils to the cut stumps was found to be very costly and was given up. Better results are expected from killing infected plants by injecting hormones such as 2, 4-D and M.C.P.A. preparations. As many banana varieties as are available are being planted on infected sites, and it is hoped tht enough immune varieties to meet requirements will eventually be found.

Precautions are being taken to prevent, so far as that is possible, the spread of the disease to clean land and particularly to other districts. The presence of banana groves along the Pangani River will however render it practically impossible to prevent spread to the Pare and Usambara Mountains and the Tanga district, but new outbreaks are being watched for and will be dealt with immediately.

Isolations were made from at least one plant in each outbreak and the fungus was grown in pure culture. Isolates appear to be of two strains differing in their mode of growth on Czapek-Dox agar. All were similar on Potato-dextrose and potato blocks. On sterilized ground rice the characteristic red to purple colour was noticeable.

The examination of banana groves for wilt has revealed the existence of much more *Armillaria* root rot than had been suspected. Although more or less destructive in particular fields this disease is not a menace to neighbouring fields.

French beans.—Routine inspection of the larger seed-bean farms was continued. The only serious outbreaks of seed-carried diseases were where large consignments of seed had been imported. The danger of sowing seed from affected crops and of sowing on affected land was again stressed. The great majority of seed-bean growers have a good knowledge of the diseases which affect their crops and the control of these is now a general routine on most farms.

The prolonged rains encouraged foot rots in several areas; *Pythium ultimum*, *Rhizoctonia solani* and a *Fusarium* sp. were isolated. The fungus *Ascochyta ?pinodes* was common following *Isariopsis griseola*.

Tobacco.—Kromnek which appeared first in 1947 and spread steadily around Iringa until 1950 could not be found in 1951; the insect vectors of the virus may have been absent.

A disease referred to as "Enation mosaic" was seen in a few plants at Iringa. It has symptoms recalling both common mosaic and Leaf-curl and may be confused with either of these diseases. It was described in Mycological Circular No. 30.

Symptoms of toxicity caused by applications of benzene hexachloride insecticide on the leaves were seen on two farms. The symptoms are described in the above Circular.

An atypical form of Angular spot (*Pseudomonas angularata*) was seen in dark leaf tobacco received from Songea. The leaf spots were much larger and more rounded than is usual and some had concentric rings.

Coffee.—Yellowing of leaves in coffee grown at Mbosi is seen each year. Among the several types of yellowing, there is one which, in association with certain other symptoms, suggests the cause to be excessive exposure and cold. The subject has been under investigation also by other officers of the Agricultural Department and by the Government Chemist, and it is hoped that definite conclusions will be drawn in the near future.

“Black bean”, a non-parasitic trouble of coffee beans, is becoming more prominent in Tanganyika as elsewhere. It clearly requires investigation by a Physiologist. The chief damage is in the discoloration of the beans which are thereby low-graded.

Passion fruit.—The virus disease Woodiness has been found wherever the plants have been examined in the Territory, i.e., in the Northern, Tanga and Southern Highlands Provinces. So far the disease has not proved particularly destructive.

A fungus *Septoria passiflorae* has been found abundant on twigs and leaves of vines which are unthrifty from other causes. The disease appears to be less severe here than in South Africa where it was first found in 1941. The presence of *S. passiflorae* in passion fruits on one estate was associated with a soil low in potash and humus and in which the roots became heavily parasitized by eelworms.

The fungus is however capable of causing some direct damage. Inoculation experiments in the laboratory showed that spores can attack healthy fruits through undamaged epidermis and cause spotting and internal rotting. Dr. A. J. Louw of the Western Province Fruit Research Station, Stellenbosch, South Africa, the original investigator of the fungus in question, kindly confirmed the identity of the Tanganyika specimens.

Potato.—Irish blight continues to cause heavy losses. Varieties of potatoes bred by Dr. W. Black at Corstorphine, Scotland, are still being introduced for trial in the Usambaras, and there are indications that one or two are immune to our present strains of the fungus. Larger quantities of these varieties are to be introduced for multiplication.

Stem canker, *Rhizoctonia solani*, was seen in moderate amount in a field near Iringa.

Tree tomato.—A virus disease, observed in the Northern Province and referred to briefly in the previous Annual Report, has been identified by Dr. K. M. Snith. He found two viruses present, these being the components of the tobacco Rosette disease complex. The disease is described in Mycological Circular No. 31. In tree tomato near Mbeya virus symptoms differ in several ways from those seen in the Northern Province, but the cause in that case has not been ascertained. It is now clearly inadvisable to have tree-tomato growing near tobacco.

Wheat.—The 1951 season has been the worst on record for Stem rust in the Northern Province. Fifty-four laboratory tests were made to determine what biologic forms of the fungus were present in samples from wheat areas. Of these thirty-eight gave positive results; K9 was the commonest, with K1 a close second. What is probably K11 was found in four of the samples received from Mbulu and Oldeani. The results have been communicated to the Senior Plant Breeder at Njoro. Many samples from the Southern Highlands Province were unsatisfactory, possibly on account of high temperatures and desiccation to which they may have been exposed in transit.

Wheat leaves from the Southern Highlands Province showed *Septoria* leaf blotch (*S. tritici*), but it is not serious. *S. nodorum* on glumes had been recorded previously and is a distinct fungus.

Scab, caused by *Gibberella zeae*, was also received from the Southern Highlands. Ears were pale and showed the perithecia of the causal fungus. Stem-bases were discoloured, some being pink; from these the conidial stage of the fungus, *Fusarium graminearum*, was isolated.

Corticium (Rhizoctonia) solani caused foot rot in wheat plants which failed to develop when the land became inundated and swampy.

Sorghum.—Experiments in controlling sorghum smuts by seed treatments with dusts were continued by field staff of the Department in several areas. At Ukiriguru a statistically designed experiment was laid out by the Botanist. For Grainsmut, treatments with sulphur and fifty per cent TMTD (R. 1104×67) give significantly better results than Nomersan or the control (no treatment).

Safflowers was badly attacked at Mombo by leaf spot, *Alternaria carthami*. This fungus was also reported to be very damaging in plantings of the Overseas Food Corporation.

Maize.—Pink ear rot (*Fusarium graminearum* and *F. moniliforme*) was again present to a serious extent.

Ocimum basilicum.—A crop of Sweet Basil was badly attacked by Downy mildew, *Peronospora* sp. The species could not be determined at the Commonwealth Mycological Institute; it differs from *P. lamii* recorded in Uganda.

Rice.—Rice in the Eastern Province showed several diseases: Blast (*Pyricularia oryzae*) at Mvomero and in the Rufiji; Brown rot (*Helminthosporium oryzae*) in several areas, and a foot rot, from which *Fusarium moniliforme* was isolated, in some fields in the Rufiji. "Narrow brown leaf spot", a rather inconspicuous leaf affection caused by *Cercospora oryzae*, was also present in some areas.

The following pathogens are recorded in Tanganyika for the first time :—
Ascochyta cynarae Died. on Globe artichoke.
Cercospora oryzae Miyake on Rice.

Fusarium oxysporum Schl. f. *cubense* (E.F.Sm.) Snyder & Hansen on Banana.

Ganoderma lucidum (Leyss. ex Fr.) Karst. on Oil palm.

Nectria rubi Osterw., and its conidial stage *Cylindrocarpon janthothele* Wr. on Cyclamen. *

Parodiella perisporioides (Berk. & Curt.) Speg. on *Neorautanenia* sp. indig.

Peronospora sp. on Sweet basil (*Ocimum basilicum*).

Phyllachora sp. on Fig.

Phyllosticta sp. on Sugar Cane.

Pseudomonas pisi Sackett on Field pea and Sweet pea.

Pseudomonas medicaginis Sackett on Lucerne.*

Pseudomonas syringae Van Hall on Lima bean.*

Pythium ultimum Trow. on French bean.

Septoria passiflorae Louw on Passion fruit.

Septoria tritici Rob. on Wheat.

Septoria sp. on *Pelargonium capitatum*.

Virus diseases : Apple mild mosaic and Cape gooseberry mosaic.

New hosts for pathogens already recorded :—

Aleurites sp., *Glomerella cingulata* (Stonem.) Spauld. & Schrenk.

Almond, *Puccinia pruni-spinosae* Pers.

Antirrhinum, *Sclerotium rolfsii* Sacc.

Banana, *Thielaviopsis paradoxa* (de Seynes) von Hohn.

Bean—Bonavist, *Ascochyta phaseolorum* Sacc.

Bean—French, *Ascochyta phaseolorum* Sacc.

Bean—French, *Corticium solani* (Prill. & Delacr.) Bourd. & Galz.

Bean—French, *Fusarium* sp.

Bean—Lima, *Glomerella cingulata* (Stonem) Spauld. & Schrenk.

Bean—Lima, *Pseudomonas phaseolicola* (Burkh.) Dowson.

Bean—Runner, Mosaic virus.

Carnation, *Sclerotium rolfsii* Sacc.

Delphinium (Larkspur), *Corticium solani* (Prill. & Delacr.) Bourd. & Galz.

Delphinium (Larkspur), ?Cucumber mosaic.

Egg plant, *Septoria Pycopersici* Speg.

Gilia, *Sclerotium rolfsii* Sacc.

Grape vine, *Armillaria mellea* (Fr.) Quel.

Hibiscus sp. *Botrytis cinerea* Pers. ex Fr.

Horse radish, *Alternaria brassicae* (Berk.) Sacc.

Lawn grass (*Cynodon dactylon*), *Corticium solani* (Prill. & Delacr.)
Bourd. & Galz.
Lucerne, *Corticium solani* (Prill. & Delacr.) Bourd. & Galz.
Pawpaw, *Corticium solani* (Prill. & Delacr.) Bourd. & Galz.
Pea, *Pythium* sp.
Pelargonium zonale, *Botrytis cinerea* Pers. ex Fr.
Potato, *Fusarium oxysporum* Schl.
Rhubarb, *Sclerotium rolfsii* Sacc.
Rice, *Gibberella fujikuroi* (Saw.) Wr.
Rice, *Nigrospora oryzae* (Berk. & Br.) Petch.
Sweet pea, *Glomerella cingulata* (Stonem.) Spauld. & Schrenk.
Sweet potato, *Glomerella cingulata* (Stonem.) Spauld. & Schrenk.
Wheat, *Corticium solani* (Prill. & Delacr.) Bourd. & Galz.
Wheat, *Gibberella zeae* (Schw.) Petch.

G. B. WALLACE,
Plant Pathologist

*Await confirmation.

ANNUAL REPORT OF THE ENTOMOLOGIST, LYAMUNGU.

FOR 1951

CROPS AND PESTS

A considerable amount of experimental work was undertaken during the year on the control of pests, partly at the expense of biological studies. The severity of the pests involved temporarily justify this move.

Coffee.—*Anthores leuconotus* Pasc., the White coffee borer remains the most serious single pest of coffee in the lower *Arabica* coffee growing areas and consequently has been the main focus of attention. A preliminary experiment laid down towards the end of 1950 and evaluated in early 1951 on the control of borer suggests that the application of certain formulations of D.D.T., and B.H.C., on the main stem of coffee can reduce the rate of infection very considerably. This was followed up by another experiment which was laid down in March in an attempt to control the beetle which emerge during the long rains. The following insecticides were used: a one per cent Toxaphene emulsion (proprietary formulation), one per cent D.D.T. emulsion using W.W. Gum Rosin as a sticker, one per cent Dieldrin emulsion with W.W. Gum Rosin and five per cent B.H.C., in oil with W.W. Gum Rosin. These insecticides were applied to the main stem of the tree only. The experiment was a failure since an insignificant number of eggs were laid in the plot which covered more than an acre of coffee. This result was surprising since on that same estate the previous year an average of 3.9 new larvæ were found per control tree. The reason for the failure is not fully understood, but it seems that the emergence time of the beetles in that estate is biennial. It was found however, at the time when the experiment was evaluated, that the insecticides were still effective against *Antestia lineaticollis* which was used as a test insect as *A. leuconotus* beetles were not available. Results can be summarized in the following table:—

Total Number of <i>Antestia</i> used per treatment = 50 imagos			
TREATMENT	Results after 72 hours exposure		
	No. dead	No. mori- bund	No. alive
Control	2	1	47
Toxaphene	16	3	31
B.H.C.	43	2	5
D.D.T.	43	1	6
Dieldrin	49	1	0

D.D.T., Dieldrin and Toxaphene treated surfaces were exposed for 126 days and 40.7 inches rain. B.H.C., treated surfaces were exposed for 113 days and thirty-five inches of rain.

Preliminary laboratory experiments have shown that *A. leuconotus* is susceptible to both D.D.T. and Dieldrin through the tarsi and through the mouth-parts.

Experiments are proceeding on these lines and another field trial was made to cover the short rains emergence towards the end of the year.

Green scale during the year has been very serious in some of the drier coffee growing areas and there is reason to believe that the application of D.D.T., used to control *Antestia* can be a factor in inducing outbreaks. The scale, *Coccus africanus*, its predators and ant attendants have been forwarded to the British Museum for checking identities. The attendant ant, probably *Pheidole punctulata*, was observed to attack lady-bird predators and in one ant nest the remains of several predators were found in a pile of insect debris.

Since grease-banding is rendered ineffective in the course of a week or two owing to dust and debris and since B.H.C., as an ant-band may cause an off flavour in coffee, other materials have been tried. The best of these appears to be a one per cent Dieldrin emulsion sprayed on the lower nine inches of stem and which remains effective against ants for several months under varying conditions. The exact period of effectiveness is not known as observations were interrupted. A one per cent Toxaphene emulsion proved to be effective for five weeks.

It was found that spraying scale-infested coffee with a two per cent white oil emulsion (a proprietary brand) while not effective when applied with hand-sprayers was fully effective when applied with at least 300 lb. per square inch pump pressure and when the tank mixture was well agitated.

Preliminary tests with Parathion applied as a spray to foliage to control the scale gave a good initial kill, but results were not lasting; the trees were being reinfested four to five weeks after the initial kill. For this reason, and as this insecticide is highly toxic to man no further investigations on the line have been carried out. Further trials on Green-Scale control are proceeding.

Mealybug increased considerably in one area on Kilimanjaro and was causing very considerable damage. On investigation it was found that the species involved were *Pseudococcus filamentosus* (Ckll) and *Ferrisia virgata* (Ckll). For the most part the mealybugs were not ant attended.

Lantana-bug, (*Orthesia insignis*) continued to establish itself in coffee in several areas in Moshi district in Native and European grown coffee, and in one estate in Arusha district. Its predators, *Hyperaspis jocosa*, were bred in the laboratory in small numbers and these were considerably supplemented from the Scott Laboratories, Kenya. Liberations were made in Moshi, Iyamungu and Kibongoto. So far only one beetle and one larva has been

recovered from the field. If the lady-bird has established itself results are not yet spectacular. It may however be too early to judge its usefulness since the first batch was only introduced in early June, although a small batch was liberated at Lyamungu the previous year.

Leaf-Miner (Leucoptera coffeella and L. coffeina) has again caused a great loss of leaf on both Native and European grown coffee and in nurseries. Good short rains masked the effect of Leaf-Miner in many places, but nevertheless it has undoubtedly prevented much of the crop ripening. This is particularly true, of course, of coffee which has not been given the best attention and which is borer-damaged.

Antestia lineaticollis.—D.D.T. has continued to control this pest extremely well and losses of coffee due to *Nematospora* are now negligible except in some native areas where D.D.T. is not used.

Leaf-distortion, an undescribed form has caused concern, particularly on the Coffee Research Station. Preliminary investigations suggest that mites may be the source of the trouble. The mites involved are minute and very similar in colour to that of a coffee leaf.

Coffee Pests in General.—Expeditions have been made to representative coffee growing areas of Kilimanjaro, Arusha, South Pares, and the Southern Highlands.

Peas.—Experiments were laid down to control *Prodenia litura* and *Laphygma exigua* in peas. The following insecticides were used:

Fifty per cent D.D.T. Wettable Powder at 2 lb. per acre, forty per cent Toxaphene Wettable Powder at 4 lb. per acre, 6.5 per cent B.H.C. Wettable Powder at 4 lb. per acre, twenty per cent Parathion concentrate at one pint per acre and twenty-five per cent Aldrin Wettable Powder at 1 lb. per acre; all were sprayed in water at the rate of sixty gallons per acre. All insecticides were applied with a knapsack sprayer and plots were surrounded by hessian to control drift.

All insecticides gave some kill when sprayed on mostly second and third instar larvæ, but there were no significant differences in effectiveness and in neither case was the control satisfactory. It was concluded that the method of application of insecticides was not satisfactory in that the pump pressure was not adequate nor the distribution of the insecticide even. At the time of spraying most of the caterpillars were feeding on the growing tip which is protected by folded stipules and leaves; this, the waxy nature of the leaves, and the frequent showers of rain probably account for the poor results. It was decided to abandon the experiment and at that time the crop was destroyed by bacterial blight. Dust trials gave very similar results, and were similarly abandoned. In this case dust was applied with small hand pumps.

Headland spraying machinery and hand lances were later tried and insecticides were applied in water at the rate of two hundred gallons per acre. No useful results arose from this experiment.

A low-volume sprayer was used by a contract firm using 3-3½ pints of a fifteen per cent D.D.T. emulsion in twenty gallons of water per acre and gave a fair control, but was not entirely satisfactory. The peas were treated when most of the caterpillars were in their last two instars when they can less easily be protected by foliage. Unfortunately enough larvæ survived to give rise to a large second generation. This low-volume machine gave a better cover and finer droplets than were possible with the experimental equipment available, but failed to reach the young caterpillars in the growing points.

Counts made before the insecticides were applied showed that the infection rate was very uneven in the plots.

Before the peas were planted a search was made in the soil for pupæ but only pupal cases could be found and it is reasonable to suppose therefore that the moths of these two caterpillars migrated in from the forest or the bush in considerable numbers since the caterpillars were established in the new pea crop early in the season.

Dwarf Beans.—Bean fields in the Arusha-Monduli areas were searched for sucking bugs likely to carry *Nematospora coryli* which caused the Yeast spot in seed beans. In spite of careful searching very few bugs were caught and yet one farmer estimated that a seven per cent loss of crop could be attributed to these insects and the fungus. It would seem therefore that very few bugs can cause considerable damage as is the case of *Antestia* in coffee.

A caterpillar, *Phytometra Orichalcea*, together with *Prodenia litura* and a few species of lesser importance threatened the bean crop. It was found that twelve to sixteen pounds of D.D.T. ten per cent dust controlled the pests with a good measure of success when distributed with a power dusting machine.

The second generation of caterpillars was more severe than the first but died out before reaching maturity, apparently by a fungus disease.

Several other lesser pests were collected including Cantharid beetles. These have not yet been identified.

Wheat.—A chafer grub caused severe losses in some areas and in some cases two or even three plantings were necessary to replace the destroyed seedlings. The adult form is not known as larvæ collected in the field died in the laboratory before reaching maturity. Several other lesser pests were noted.

ACKNOWLEDGMENT

Acknowledgment is gratefully made to the Entomological Staff of the Agricultural Department of Kenya for help and discussion; to the Commonwealth Institute of Entomology for identifying specimens; to the Staff of the Colonial Insecticide Research Unit, Arusha; and to many firms who have provided insecticides, solvents and apparatus.

R. G. TAPLEY,
Entomologist

ANNUAL REPORT OF THE ENTOMOLOGIST, MOROGORO, FOR 1951

INVESTIGATION AND DEVELOPMENT

Stalk-borers of maize and sorghum.—Reports are received without fail every year of the depredations of *Proceras argyrolepidi*, Hmps., and *Busseola fusca*, F. This year heavy damage has been reported on early planted native crops in widespread areas of Western, Lake, Central, Northern and Southern Provinces. European maize at Njombe suffered severely.

Study of the problem at Ukiriguru, near Mwanza, indicated that the first plantings made after the end of the dry season were more heavily attacked than the later ones.

Further observations in the Tabora and Morogoro districts have shown that the stumps of the plants left in the ground after harvesting form breeding sites where both *Proceras* and *Busseola* bridge the dry season from the end of May to the beginning of the short rains; and under the conditions of peasant agriculture the sorghum residues are of greater menace than the maize. Towards the end of the dry season the tillers which have developed from the sorghum residues are the most important source of the population which will attack the early plantings.

Further work on this problem, especially from the point of view of native agriculture, is being carried on in the coming year.

Grain Storage.—Special investigation has and is being made of the suitability to Tanganyika conditions of the underground pit method of storing grains which was developed in Argentina during the war years. The first of three 120-ton pits was sealed in Morogoro on 23rd October: by the 9th November the weevil infestation had been reduced by carbon dioxide increase from approximately 4 per pound of maize to 0.2. Sampling one month after sealing showed all weevils to be dead. The other two experimental pits are under construction at Dodoma and Moshi and should be filled and sealed early in 1952.

In bag stores operated by the Department of Grain Storage, the losses in the 1950/51 storage season, despite some external dusting of sacks, amounted to approximately 4.5 per cent of the total received. Some evidence has been gained towards the end of the year that part of this loss is due to drying out in storage as well as to direct loss by weevil attack. Work on the problem is continuing.

American Bollworm on Cotton.—Large scale hand dusting trials in the Mvomero district of Eastern Province with dusts containing 10 per cent D.D.T., 10 per cent D.D.T. plus 2 per cent Nicotine, 10 per cent D.D.T. plus 3 per cent B.H.C., and B.H.C. alone gave a significant, but uneconomic, result in favour of the 10 per cent D.D.T. dust. Parallel, but smaller and

more detailed, trials by the Empire Cotton Growing Corporation staff gave an economic return with the mixed D.D.T./B.H.C. dust as the best insecticide. Considerable trouble was experienced in the large scale trial with the type of duster used; it can only be assumed that the inefficiency of these applications was responsible for the uneconomic result obtained.

Coconut Sucking bug, Theraptus sp.—Together with Mr. M. J. Way, a Rothamsted entomologist until recently seconded to the Zanzibar Clove Research Scheme, general surveys have been made of the distribution of this Coreid bug on the Tanganyika mainland and on Mafia Island. The insect has been found in the coastal belt from north of Tanga to Kisiju, south of Dar es Salaam, and to a minimum depth of twenty miles inland. On Mafia Island it was found to be mainly concentrated in one area south of the town of Kilindini where relatively healthy palms were growing. Elsewhere on the island, where the condition of the palms was poor owing either to neglect during the war years or to waterlogging, *Theraptus* was only present in small numbers. The damage done, causing the fall of young nuts and reducing copra yield from older ones, is obviously very great.

The biological relationship between *Oecophylla longinoda*, Latr., an ant which is predatory on *Theraptus*, and the two ants, *Pheidole megacephala*, F. and *Anoplolepis custodiens*, Smith., whose presence appears inimical to *Oecophylla*, are by no means clear. A special study of the problem is being made by an entomologist appointed by the Zanzibar Government who will carry out his investigations both in Zanzibar and on the Tanganyika mainland.

SURVEY OF CROPS AND INSECT DAMAGE

(a) Food Crops

Cereals.—Reference has already been made to widespread maize and sorghum damage by *Proceras* and *Busseola*. In Lake Province the Anthomyid fly, *Atherigona indica*, Mall., caused considerable losses in sorghums and contrary to general past experience was present from the beginning of the growing season. In Central Province the insect did damage to later planted sorghums only.

Some concern has been expressed in Arusha and Moshi at the unusually high incidence of late-season field infestation of maize cobs by *Calandra oryzae*, L.; the infestation, coupled with delayed drying due to high humidities, caused local spectacular damage. Early field damage by this insect occurred on dwarf sorghums being grown at Mahiwa in the Southern Province.

During late December outbreaks of army worm, *Laphygma exempta*, Wlk., were recorded on maize in Singida and Morogoro. *Panicum miliaceum* grass being grown experimentally at Kingolwira was heavily attacked, practically 180 acres being destroyed before any control measures could be put in hand.

Amongst other insects reported as causing damage on a smaller scale were larvæ of an *Epilachna* sp. attacking maize and eleusine in the Olmotoni area of Northern Province; *Calidea dregii*, Germ., attacking maturing

sorghum grains in the Central Province; and a *Dydercus* sp. breeding on short term sorghums planted on newly-cleared bushland near Mombo. (*D. nigrofasciatus*, St., has a short time ago been reported breeding under similar conditions on sorghums in Nigeria.)

Extensive damage to early planted maize has been done in the Bagamoyo and Kilosa districts by plague populations of the field mouse, *Mastomys microdon coucha*.

Bananas.—Increase in the numbers of banana weevil, *Cosmopolites sordidus*, Germ., in the Bukoba district has given rise to concern, particularly as plantains are the staple food crop; a campaign against this insect was initiated by the Agricultural staff towards the middle of the year.

Root Crops.—Cassava scale, *Aonidiomytilus albus*, Ckll., has been reported from Lindi and has been observed by the writer in the Dar es Salaam district. Reports from Ukerewe Island, where heavy damage was caused in the previous two years, indicate progressive improvement of the situation as a result of the selection of clean cuttings for planting.

(b) Cash Crops

Castor.—The Capsid bug, *Helopeltis bergrothi*, Reut., caused considerable damage to native and European castor in the Mpwapwa district. Control measures in the European castor with an unspecified D.D.T. dust and an 0.1 per cent D.D.T. wettable powder achieved a measure of success. The pest in native castor was stated to have lingered on in damp valley bottoms after the main attack had subsided. In the Kisaki district of the Eastern Province the Lymantrid moth, *Arctornis producta*, Wlk., was responsible for some foliage damage to this crop. Two unidentified pests were observed in addition to *Helopeltis* and *Arctornis*, a Cossid stem-borer in native castor at Mvomero, and a Pentatomid bug in European castor at Moshi. The damage caused by the latter insect to the flowering spikes is similar to that of *Helopeltis*.

Cotton.—Cotton pests in the Lake Province have been present on only a very minor scale. Particularly intensive attacks of American Bollworm (*Heliothis armigera*, Hb.) occurred in parts of Eastern Province where peak populations of over 8,000 larvæ per acre were recorded from some areas. It has been estimated that this pest is capable of causing the loss of one-third of the cotton crop in an outbreak area. Late season staining in Eastern Province was caused by *Dystercus fasciatus*, Sign.; in Northern Province stainer damage was reported as severe. Pink bollworm, *Platyedra gossypiella*, Saund., was prevalent towards the end of the season in the Kilosa district. Local depredations of the field mouse, *Mastomys microdon coucha*, further reduced yields in Kilosa.

Tobacco.—Tobacco cutworm and eelworm, although present as usual in the Iringa tobacco areas, have not been reported as severe: trials carried out against them gave no significant results owing to the paucity of the pests on the experimental plots. Investigation of the cutworm problem is being made by the newly appointed entomologist.

An outbreak of the leaf-eating weevil, *Systates brevicollis*, St., was controlled by hand dusting with 0.45 per cent gamma B.H.C. dust. Some foliage damage attributable to this insecticide has been reported.

The tobacco beetle, *Lasioderma serricorne*, L., was observed in a consignment of scrap sent to the Iringa factory. This parcel, together with the contents of the barn from which it originated, was promptly burned.

Legumes.—Local heavy damage was done to peas at Arusha by larvæ of *Prodenia litura*, F., and another unidentified Noctuid. In the Ufipa district of Western Province the main cash crop, dwarf beans, was successively damaged by *Melanagromyza phaseoli*, Coq., *Ootheca bennigseni*, Wse., and the Meloid beetles, *Mylabris tripartita*, Mars., and *Coryna guineensis*, Chas.

The fungus, *Nematospora coryli*, which is stated to have caused approximately five per cent damage to seed beans in the Northern Province is suspected of being transmitted by a plant bug.

MISCELLANEOUS REPORTS

A reduction in the numbers of Coffee-Berry Borer, *Stephanoderes hampei*, Ferr., was reported from Bukoba; this was stated to be due to the stimulus given to the picking of fallen cherry by the current high prices for coffee.

Hibiscus being grown experimentally for fibre production at Lindi was damaged by the leaf-eating Halticid, *Nisotra suahelorum*, Wse. From the same province sesame was reported to have been attacked by *Apthora bimaculata*, Jac.; and soya bean, both in the field and in storage, by a *Bruchus* sp.

Sorghums in Central Province were slightly damaged by a borer new to Tanganyika which has been identified as *Chilo zonellus*, Swinh.

Cabbages in the Morogoro district were attacked by the diamond-back moth, *Plutella maculipennis*, Curt., and the aphid, *Brevicoryne brassicae*, L.; whilst carrots were damaged by larvæ of the saw-fly, *Athalia sjostedti*, Kuhm.

The Hemipteran, *Hilda patruelis*, Stel., previously reported from cashew nuts and groundnuts, was observed breeding on orange trees in Morogoro in August. This insect was associated with a scale *Phenacaspis* sp., living on the young terminal shoots.

ADDITIONS TO THE LIST OF INJURIOUS INSECTS

Theraptus sp. Causing nut fall and gummosis of coconut.

Phenacaspis dilatata (Green)—flowering spikes of coconut.

Halydicoris corticinus, Germ. — sucking immature sorghum grains.

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Thanks are again due to the Director and staff of the Commonwealth Institute of Entomology for the identifications they have made throughout the year.

G. SWAINE,
Entomologist

SUMMARY OF BOTANIST'S ANNUAL REPORT FOR 1951

SORGHUMS

Breeding Work

General.—A study of the selections taken indicated that there was little material of any value, and the emphasis was shifted to hybridization work. Indigenous short-term sorghums of less than $4\frac{1}{2}$ months maturity have not yet been noticed; all the short-term sorghums grown here are foreign to Tanganyika, and mostly possess grains that store badly. Certain of the American varieties have better grains, but the plants themselves go down badly with leaf diseases. Selections taken possessing the required grain characters have all been evident hybrids, and the progeny from them unsuitable plants. Deliberate hybridization therefore seems to offer the best prospects of success.

Selections.—A large number of the 1950 selections were rejected, but 921 re-selections were made from the remainder. Unfortunately, many of those assessed as very good storers had to be discarded. Eighty-five primary selections were taken, many of them for vigour and yield, as potential parents for later stages of the work, and 54 selections were taken from Wiru bulks.

Hybridization.—The F_2 generation of B.C.27 white $\times$ D.D. Shallu and Dobbs $\times$ D.D. Shallu were grown out. Sixty-seven plants showing grains with a corneous endosperm were taken as selections, and the four best from each cross were back-crossed to the B.C.27 and Dobbs varieties respectively.

Wiru (long term, very good storer) was crossed on to B.C.27 ($3\frac{3}{4}$ months, poor storer), to Dobbs ($4\frac{1}{4}$ months, poor storer), and to Martin and Oklahoma 44/14 (American combine types, $3\frac{1}{2}$ months, Oklahoma a poor storer, Martin slightly better). The first backcross of the B.C.27 $\times$ Wiru to B.C.27 was also completed.

Kifaru, which has a very large yellow grain, and may be less liable to bird damage than the smaller grained types, was crossed on to B.C.27 and Dobbs.

The crosses (B.C.27 $\times$ Wiru) with (B.C.27 $\times$ D.D. Shallu), (B.C.27 $\times$ Wiru) with (Dobbs $\times$ D.D. Shallu), and (B.C.27 $\times$ Wiru) with Kifaru were also made. The object of the crossing programme is to transfer the good storing qualities of the grain of certain of the indigenous long-term sorghums to reliable early maturing types, together with a large grain. The programme will be extended next year.

Small Bults.—One hundred and sixty-four varieties were grown in one-forty-eighth acre plots, and full observations taken on panicle and vegetative characters, maturity, and incidence of leaf diseases.

Introductions.—Two hundred and twenty-seven introductions were grown in single row plots, and of these sixty-seven were carried on for further observation. New introductions included ninety-three from the Overseas Food Corporation collection at Kongwa, and Belko, a variety from the Gold Coast with an extremely hard grain which is reputed to be 'all weather'. This may be an important character, as many of the local grains are severely damaged by mildew when ripening in wet weather.

Striga.—Striga counts on the trials at Ukiriguru, Lubaga and various district plots confirmed previous years' observations that Dobbs carries fewer mature Striga plants than most other sorghum varieties, while still maintaining a good yield. The results have not yet been analysed. Twenty-two selections for striga resistance were taken from Dobbs, growing on heavily infested soil.

Experimental.—Variety trials (twenty-five sorghum varieties in each) were run at Ukiriguru and Lubaga. Great difficulty was experienced in establishing a stand at Ukiriguru, and the figures from these are a reflection of the ease with which the varieties were established. Few conclusions may be drawn from them.

The Lubaga trial was satisfactory. Some extracts are given below, yields being given as percentage of the general mean in each case.

LUBAGA

<i>Variety</i>	<i>Percentage of general mean</i>	<i>lb./acre grain</i>
Dobbs No. 4	149	1,720
Dobbs	142	—
Martin	136	—
Dobbs No. 3	132	—
Caprock	128	—
Schrock	121	—
Oklahoma 44/14	117	—
D.D. Shallu	115	—
P. 41	96	—
D. Shallu 5463-34	86	—
D. Shallu 5463-37-3	85	—
D. Shallu 5631-12	84	—
Bukura Mahemba	71	815

UKIRIGURU

<i>Variety</i>	<i>Percentage of general mean</i>	<i>lb./acre grain</i>
Schrock	120	1,650
Caprock	190	—
Martin	184	—
P. 41	182	—
Dobbs	174	—
Oklahoma 44/14	133	—
D.D. Shallu	106	—
D. Shallu 5631-12	85	—
Bukura Mahemba	65	510

Variety and Spacing Trial.—Again there was difficulty in establishing a stand, and figures should be treated with reserve. The yields, ignoring spacing, were as follows :—

<i>Variety</i>	<i>Percentage of general mean</i>	<i>lb./acre grain</i>
Dobbs	199	1,190
Bukura Muhemba	120	710
Martin	72	430
D. Shalla 5463-37-3	65	390
P. 41	44	260

The figures from these three trials are in line with those obtained last year, and indicate that Dobbs can often outyield Bukura Muhemba, a very popular native variety: they justify its choice as a parent in the breeding work. Martin has again shown that it can give a satisfactory yield, and the fact that the Shalla sorghums are on the whole light yielders is confirmed.

Weeding Trial.—This trial tested three times of weeding (sorghum 4" high, 7 days later, 14 days later) against 1, 2 and 3 weedings. An analysis is not available, but the following results indicate that early weeding is more important than the number of weedings (Expressed as percentages) :—

First Weeded when sorghum four inches high...	133%
First Weeded seven days later ...	105%
First Weeded fourteen days later ...	100%
Weeded once ...	100%
Weeded twice ...	105%
Weeded three times ...	110%

This is in accordance with last year's results.

Treatment against Smut.—An experiment on seed treatment of sorghum with three fungicides was done for the Plant Pathologist. Results are as follows :—

COVERED SMUT

<i>Fungicide</i>	<i>None</i>	<i>Normersan</i>	<i>Sulphur</i>	<i>T.M.T.D.</i>
Percentage infected plants ...	14.5	11.3	6.1	5.1

Sulphur and T.M.T.D. are significantly better than no treatment and Normersan at $P=0.05$.

LONG SMUT

<i>Fungicide</i>	<i>None</i>	<i>Normersan</i>	<i>Sulphur</i>	<i>T.M.T.D.</i>
Percentage infected plants	5.9	3.3	2.0	1.3

The three fungicide treatments are significantly better than the untreated seed, but do not differ between themselves at $P=0.05$.

Compost Re-inforcing Experiment.—This experiment is a comparison of compost, phosphate, compost mixed with phosphate in the heap, and compost mixed with phosphate in the drill. Treatments were applied in the 1949-50 season, and this year the first residual effected were measured.

Control	100%
Compost, 6 tons/acre	145%
Triple superphosphate, 90 lb./acre	120%
Compost 3 tons, triple super 45 lb. in heap...	120%
Compost 3 tons, triple super 45 lb. in drill ...	129%
Sig. Diff. (0.05)	35%
Control yield. 455 lb./acre. Dobbs sorghum.	

MAIZE

A ploughing v. non-ploughing trial was planted to maize; the not-ploughed treatment had not been ploughed for two seasons. The crop was planted on the flat. The percentages are of grain yields.

Ploughed	...	100%	} 6 replications
Not ploughed	...	93%	

Growth was irregular, and the difference between ploughing and not ploughing is not significant.

MILLET

Sixteen varieties of bulrush millet were grown, of which eleven were planted in a variety trial:—

<i>Variety</i>	<i>Percentage of Native Millet</i>	<i>Yield lb./acre</i>
Bajiri A.F. 3	105	1,030
Indian Long Headed	103	1,015
Native Millet	100	980
Bajiri 28.15.30.32	99	970
Red Awmed	91	890
Ifeti	90	880
Awmed Bulrush	84	820
P.T. 786	83	815
Bene Awmed	75	740
Quick Maturing	63	615
Ameli	52	515

Generally speaking, yield and length of maturity are correlated, Ameli being ready in about 70 days, compared to 105-110 for Native Millet, 115-120 for Bajiri A.F.3. In all cases the "varieties" in this list were a mixture of types, and bulks of them were rogued and selected to obtain greater uniformity.

Five varieties of finger millet, three of Setaria Millet, and one of Panicum Millet were also grown.

LEGUMES

Nineteen varieties of soya bean, 13 varieties of groundnuts, and 31 varieties of other legumes were grown in observation plots. Soya bean and cow-pea variety trials were planted, but stands were poor, and the results are not worth recording. Of the soya beans, Yellow Kedele was the best.

CASSAVA

Seventeen new varieties from Amani were planted, and hopeful material from previous plantings was bulked up for further observation. Scale has proved impossible to eliminate, but last season the attack was light, although widespread.

MWABAGOLE

General.—The level of the water in the furrow from the lake was very low at the beginning of the season, which hindered irrigation of the seed beds, and labour was extremely scarce. As a result, the majority of the rice was planted late, and was not harvested until after the Botanist had gone on leave.

Selection work.—116 of last year's selections were kept, to be carried on for observation and trial, the remaining 790 being discarded. 294 re-selections were made, and 95 selections taken from among last year's introductions.

Experimental.—The whole experimental programme had to be abandoned, with the exception of two variety trials, owing to the labour shortage.

A 25-variety trial with 6 replications was planted, to compare varieties which have been grown on the station for some years. The poorest of them are to be discarded.

A 49-strain trial with 8 replications was also done, to compare the best of the 1949 selections with the parent varieties from which they were taken. On the whole, the selections showed up well, several of them apparently being superior to their parent varieties, but figures cannot be given until the analyses are completed.

H. DOGGETT,
Botanist

ANNUAL REPORT OF THE FISHERIES OFFICER (INLAND) FISHERIES, 1951

Mr. G. J. Lockley, Fisheries Officer (Inland) was on vacation leave, without relief, until mid July. On his return he was largely occupied with a backlog of technical inquiries and administrative matters and field work was mainly restricted to the last quarter of the year. During his absence a part-time European Clerk was employed to maintain the work of the Kigoma office, including the collection of fisheries statistics. A Grade I Asian Clerk joined the staff in November.

The forty-five feet Motor Fishing Vessel, which it was anticipated would be in commission on the Fisheries Officer's return from leave, was still not completed at the end of the year. This work is being undertaken by the Marine Workshops of the E.A.R. & H. at Kigoma and the delay has in the main been due to the necessity and to give priority to the refit of their lake steamer *Liemba*.

A considerable quantity of experimental fishing gear was selected and ordered whilst in the United Kingdom and much of this had arrived at Kigoma by the end of the year. Several aquarium tanks have now been installed at the Inland Fisheries Office. These are in use both for the study of the habits of certain Lake Tanganyika fishes and for the building up of small stocks of fish for onward transport to ponds, dams, etc.

There has been a steady increase in the advisory work carried out from the Kigoma office and inquiries have included several from other territories. Services rendered included identification of fish specimens, advice on methods of fishing and the construction of fishing gear and advice on the construction and stocking of fish ponds. Considerable correspondence was conducted with manufacturers and importers of fishing gear in an endeavour to obtain adequate supplies for the Territory.

All the riparian administrative districts of Lakes Tanganyika and Rukwa were visited, work was carried out on the Malagarasi River and Swamps and certain rivers, dams, ponds and sites for ponds were inspected in the Tabora, Mpanda and Ufipa districts of the Western Province.

In November Mr. Lockley attended a meeting of the Lake Victoria Fisheries Board at Kisumu and represented the Territory at the 4th Meeting of the East African Inland Fisheries Research Advisory Committee at Jinja.

His Excellency the Acting Governor inspected the Inland Fisheries Office in May.

The Fisheries Ordinance (No. 36 of 1950) became law in October, 1951.

LAKE TANGANYIKA

The Lake Tanganyika *dagaa* industry, the Territory's most valuable single fishery, has in the aggregate enjoyed a prosperous year. Known

exports (see Appendix) have amounted to 1,214 tons of dried *dagaa*. This is a considerable shortfall on the figure of 1,663 tons exported in 1950, a record year. On the other hand there has been a big rise in the price obtained for this product from an average of £60 per ton f.o.r. Kigoma in 1950 to £100 per ton in 1951. The value of the 1951 exports at £121,400 (approx.) therefore exceeds those for 1950 by some £10,000. In spite of the price, demands have kept pace with, and at times exceeded, supplies.

The *dagaa* shoals have been plentiful and the fishery has been prosecuted with vigour in most areas. Strong winds during the dry season hindered fishing to some extent and early and continuous rain at the end of the year interfered with the sun-drying of the catch but the major setbacks to the industry during the year has been one of communications. Approximately one half of the annual total catch comes from southern lake ports, mainly in the Ufipa district. For some 250 miles of coastline, from beyond range of Kigoma to the Northern Rhodesia border, this fishery relied on the regular visits of the E.A.R. and H. lake steamer *Liemba* for the evacuation of its products to Kigoma, for the movement of migrant fishermen and buyers and for the receipt of gunny-bags, trade-goods, etc. In November 1950, at the height of the *dagaa* season, the *Liemba* was suddenly removed for a major refit and, at the time of writing, it is unlikely that she will be in commission again before 1953. It was not until the end of March 1951 that the small tug *Mwanza* towing two (and later only one) lighters was put on this run. Neither the *Mwanza*'s cargo capacity nor its third class passenger accommodation are sufficient for the needs of the *dagaa* fishery. Towards the end of the year the Railways made considerable efforts to clear outstanding loads of *dagaa* from some of the ports (largely at the expense of the less perishable paddy crop) but much still remained. An unknown, but apparently limited, amount of *dagaa* was moved from the Karema-Ikola region by road and rail via Mpanda. The fisheries and the life of the scattered lakeshore population were so closely bound up with the *Liemba* schedules that the effects of the present change have been widespread and not yet fully felt. In certain areas, now lacking buyers or unable to dispose regularly of the catch, fishing has been seriously reduced. Conversely, fishing intensity has increased in areas within canoe or dhow reach of Kigoma and some of the regular ports of call of the *Mwanza*. The shortage of supplies from the southern ports was one of the main factors leading to the present price increase which has mainly benefited the fishermen of Kigoma district.

In Kigoma district the wealth obtained from *dagaa*, coupled with the lack of suitable consumer goods (including fishing gear), has acted as a deterrent to other, less profitable, forms of fishing. Although the construction of the new fish market at Ujiji has led to more orderly sales, the shortage of fresh fish in the Kigoma-Ujiji area remains as acute as ever. Where seine-netting, and other methods which exploit the larger species of fish, were carried out above the subsistence level, it was mainly the work of "foreign" immigrants.

Natives from Nyasaland and the Congo, Jalu from Kenya and Bahaya from Bukoba have made a small but useful contribution to fish supplies during the year. A Nyasa native, operating from Kibwesa, on the lake-shore 120 miles south of Kigoma, has started a small smoked fish business whose products are finding a ready export market in the Belgian Congo.

Supplies of nets, twines and other fishing gear have been poor and sporadic. Whilst the Fisheries Officer has been able to interest certain manufacturers and importers in existing and potential markets for fishing gear in the Lake Tanganyika area, the bulk of net imports continues to go to the Lake Victoria area. Local retailers show very little enterprise in this direction and, when supplies have been offered, there has been some apathy not unconnected with the need for cash with order. It is evident that ordinary commercial methods cannot be relied on to keep the fishermen supplied with the tools of their trade and the time is ripe for Government to consider ways and means of overcoming this difficulty.

THE MALAGARASI

The Malagarasi Swamps in the Nguruka-Usinge area continued to yield abundant catches of *Tilapia*, although no reliable statistics of quantities reaped were forthcoming this year. The trade is mainly in smoked fish although irregular supplies of fresh fish are sent to Kigoma, Tabora and intermediate stations. The European firm at Katara have not yet been able to install their freezing plant which has limited their fresh fish trade to catches made just before train departures. They have produced a quantity of smoked fish for export to the Congo. By the establishment of a cash market for fish, this firm have freed some of the fishermen in the area from their debts to, and dependence on, the Wajiji middlemen.

The opening of the branch railway line to Mpanda has given a considerable stimulus to fishing in the Ugalla. In the open river stretches of the Malagarasi and its tributaries, *Tilapia*, although present, do not dominate the fish fauna as in the swamp areas. The Ugalla fishermen are mainly exploiting such species as the "Kukuru" or Moonfish (*Citharinus gibbosus*) and the "Msebele" (*Alestes macrophthalmus*).

Experimental fishing at Uvinza, in the open Malagarasi and its tributary the Ruchugi at the confluence, has again shown that there are abundant stocks of several species of fish for the taking. The considerable native population at Uvinza show little interest in fishing, all the more surprising when there is a ready-made market on their doorstep with the large labour force employed with the Nyanza Salt Works.

During the year a road was constructed from Kigoma to Iragalla on the Malagarasi delta which should do much to stimulate a fish trade on the lower reaches of the river. There is a basket-trap fishery, mainly for *Tilapia*, in the many creeks and backwaters of the delta, which is capable of considerable expansion.

Routine fishing operations in the Malagarasi system, which have been limited to those few areas where there are existing or potential commercial fisheries, continue to yield species of fish which are either new to science or were hitherto unrecorded from the lake Tanganyika Basin. There is little doubt that a properly organized scientific expedition, exploring the whole of the Malagarasi, would obtain results of exceptional interest. One hundred and eighty specimens of Malagarasi fish have been forwarded to the British Museum (Natural History) for identification but have not yet been reported on. They include an unknown species of *Serranochromis*, a genus of predaceous *Cichlidae* noted in the Rhodesias and South Africa for its sporting and culinary qualities and hitherto not recorded from East Africa; several species of *Cyprinidae* (the Carp family), some of which attain a large size in the open river; species of *Mormyridae*, fatty fish rich in oil, which are abundant in both river and swamps and species of *Characidae* and *Citharinidae* which are already of commercial importance.

LAKE RUKWA

An investigation of Lake Rukwa, which had been closed to fishing since the drought of 1949, was undertaken in September. A very satisfactory amount of water was then present in this exceedingly shallow lake and, with early and heavy rains in the catchment area at the end of the year, Rukwa was recovering its pre-drought status as a lake.

Experimental fishing showed that, on the whole, the fish fauna had regained its previous character although there have been changes in the relative abundance and distribution of certain species due to such factors as the encroachment of vegetation in the marginal areas and the reduction of the crocodile stocks. It is significant that for the first time since 1949, species which are considered to be intolerant of a low oxygen content or excessive alkalinity of the water, were again found to be present in some abundance.

The "Ngege"—*Tilapia rukwaensis*, which was the mainstay of the former commercial fishery, was abundant in all stages from small fry to breeding adults. An examination of a considerable number of fish indicated that this species is reaching sexual maturity at a smaller size than formerly and appears to be making little growth after the onset of breeding. The fish, though small, were in good condition. The average weight of the individual *Tilapia* in what was considered to be the fishable stock was 12 oz. as opposed to 18 oz. in the pre-drought fishery.

Stocks of the "Kambale" or Catfish (*Clarias mossambicus*) were everywhere abundant and continued to form the main catch of the indigenous native fishery. Another species of Catfish, the "Matanda" or Butterfish (*Schilbe mystus*), a voracious predator, was present in considerable quantities as was also the "Ningu" (*Labeo fuelleborni*) and, to a lesser degree, the Tigerfish (*Hydrocyon lineatus*).

As a result of these investigations the Fisheries Officer recommended to Government that the Rukwa fishery should be re-opened in 1952. Under

Section 8 of the Fisheries Ordinance, a Lake Rukwa Fisheries Board was established in November (G.N. No. 1957 of 30.11.51) and, at its first meeting, it was decided that the fishery would be resumed on 1st February, 1952.

The fishery will be conducted by a European licensee who, in addition to operating his own nets, will be required to purchase and process the surplus catch of the local natives. In framing the regulations emphasis has been placed on the necessity for full exploitation of the fish resources of the lake and the licensee is required to purchase species other than *Tilapia* and to consider ways and means of producing fish meal from fish offal and from fish not suitable for human consumption.

The restriction of the size of mesh and seine nets to a minimum of four inches has been abandoned in favour of a restriction on the size of *Tilapia* to be landed (nine inches overall length). A minimum mesh size of four inches has been imposed for gill and other set nets. No size restriction will be in force for any species other than *Tilapia*, no limit has been placed on the number of nets that may be fished at present and no close season has been suggested at this stage. These measures have been designed to assist the fishery in its recovery and it is emphasized that regulations for the development or the protection of the fish stocks are not rigid and, with the powers of the Fisheries Board, may be altered to meet a changing situation.

CROCODILES

The Fisheries Ordinance includes provision for the control and regulation of the crocodile hide industry where necessary. The Fauna Protection Ordinance of 1951 requires (Sections 17 and 18) the permission of the Game Warden before crocodiles may be hunted and empowers the Game Warden to impose conditions in such permits for the proper regulation of the crocodile industry. The Fisheries Ordinance has not been applied to crocodiles in the Lake Rukwa area which has been declared a Controlled Area under the Fauna Protection Ordinance. The Game Warden is represented on the Lake Rukwa Fisheries Board and it is considered that adequate safeguards exist.

The boom in crocodile hides appears to be over and during the year there was a considerable drop in the prices obtained for wet-salted skins. The Rukwa industry continues, and also serves as a headquarters for activities on other waters in the Southern Highlands Province, notably the Ruaha and Lower Kiwira rivers. Elsewhere, the small-scale European operator appears to have dropped out of the picture; at the end of the year there were none such left in the Western Province. In the Malagarasi area the trade has now been mainly taken over by Arabs. Two thousand, seven hundred and forty-eight certificates of ownership of crocodile skins were issued from Kigoma in 1951.

G. J. LOCKLEY,
Fisheries Officer (Inland)

ANNEXURE
MONTHLY EXPORTS OF DRIED DAGAA FROM KIGOMA
All figures in Tons

1951				<i>Territorial destinations</i>		<i>Belgian ports</i>
January ...	...	...	...	56.2	...	—
February ...	...	...	...	87.6	...	47.9
March ...	...	...	...	46.8	...	—
April ...	...	...	...	65.5	...	55.1
May ...	...	...	...	70.9	...	6.2
June ...	...	...	...	38.0	...	—
July ...	...	...	...	15.1	...	—
August ...	...	...	...	75.5	...	—
Septem ber	...	...	...	146.7	...	66.8
October ...	...	...	...	92.0	...	35.3
November	...	...	...	96.0	...	26.3
December...	...	...	...	89.2	...	96.7
				879.5	...	334.3
					1,213.8	

REPORT OF THE FISHERIES OFFICER (MARINE) FOR 1951

GENERAL

The *Research* was joined for a voyage to Mombasa, and for experimental fishing in waters on the east and west of Pemba and Zanzibar.

Grounds round Latham Island were visited in the *M.V. Patoni*, and fishing grounds round islands near Dar es Salaam were visited by motor launch.

Various villages in the Eastern and Southern Provinces were visited, from the Ruvuma to north of Mikindani, experimental oyster-beds at Tanga were visited; the "Inn by the Sea", near Dar es Salaam, required advice on the possibility of stocking a nearby fish-pond with *Tilapia*, and a report was sent to the Fisheries Officer (Fish-farming).

SHIPS

Various firms in Britain, South and East Africa were approached over the question of obtaining a suitable vessel for Marine Fisheries Work.

It was decided to purchase the *Patoni*, a motor fishing vessel, from Mr. Bainbridge of Zanzibar, and to have a dinghy built at the Dar es Salaam boat-building yard.

LEGAL QUESTIONS

The Game Department of Kenya, and the Bureau de Pêche of France were approached over the question of foreshore rights, and were very helpful in explaining the position as it obtains in Kenya and in France.

In addition a summary of correspondence, and notes on the present legal position with regard to the granting of rights to gather various produce from the foreshore and near seabed, as it obtains in this country, were produced.

SCIENTIFIC WORK

Many specimens of fish have been examined, and over fifty different kinds recognized. Most have been identified, and the Systematic names equated with English and Swahili names. A card index system for recording the different kinds of fish has been devised, and a reference collection of specimens has been started.

PROGRAMME FOR 1952

When the Department's ship is ready, it is proposed:

1. To investigate various fishing grounds and methods.
2. To demonstrate economic possibilities.
3. To continue with the survey of the Native fisheries with a view to possible future improvements, on the lines already laid down.

A brief summary of the year's observations is appended.

E. H. O. MARTIN,
Fisheries Officer (Marine)

SUMMARY OF PRELIMINARY OBSERVATIONS MADE ON THE NATIVE FISHING
INDUSTRY OF THE TANGANYIKA SEABOARD, AUGUST TO DECEMBER, 1951

A. *Chief types of vessel.*

- (a) *Ngalawa*.—A narrow outrigger canoe, manned by one, two, or more occasionally three men; used for trap-laying, line and net fishing.
(b) *Dhows*.—Of varying size, with crews of six or more.
These boats can handle the larger nets and larger fish.

B. *Methods of Capture.*

I.—*Traps*.—(a) Shore traps of varying design, briefly classifiable as :

- i. Parallel to its shore line.
- ii. Normal to its shore line.

(b) Basket traps, from two feet to six feet in diameter, laid in shallow water, usually from *Ngalawa*.

II. *Nets*.—(a) Large and small mesh nets used in a seining operation.

(b) Throwing net.

(c) "Black sheet"; net of black cloth and sacking operated in shallow water by four or more women.

III. *Lines*.—Various.

C. *Fish Captured.*

I. *Traps*.—(a) 1. *Along-shore traps*.—Very miscellaneous. Flatfish (Bothids, cynoglossids) of moderate size, and small lethrinids, carangids, etc.

2. *Across-shore traps*.—In bays and estuaries particularly, fair quantities of good sized Mugilids are caught, e.g. *Mugil strongylocephalus*.

Various smaller fish, e.g. Mullids and small Lutianids are also taken.

(b) *Basket traps (Madema)*.—Catch extremely various. Lethrinids and Siganids often form bulk of catch; mullids, labrids, callyodontids, are also common, together with many of the smaller shallow water fishes, e.g. chaetodontids.

II. *Nets*.—1. *Inshore seining*.—The usual heterogeneous selection of shallow water fishes, with Lutianids, mullids, *Tylosaurus* sp., etc.

2. *Nyavu: normal mesh nets*.—Various; catches tend to select one species: Siganids, carangids, etc.

3. *Jarifu: very large mesh nets, e.g. eight inches knot to knot*.—Sharks, large skates and rays.

4. *Throwing nets* } Small fish swarming in the shallow
water. *Sardinella* sp. *Leiognathus*.
5. *Black sheet* } *Equula*, and tiny *Sphyraenids*, etc.

III. *Lines*.—Shark, the larger serranids, Lutianids, etc. Various smaller fish.

D. *Transport*.—Fresh fish }
Cooked fish } By bus where available largely by bicycle.

Dried fish. Particularly dried shark, by dhow along coast.

E. *Identification*.—Of fifty-one different types, forty-seven have been traced to genus, thirty-five to species.

F. *Other seafoods*.—In suitable localities lamellibranchs are gathered in large quantities for food. Crawfish are frequently caught in basket traps. Octopus are gathered in large numbers for local consumption.

REPORT OF BEESWAX OFFICER FOR 1951

APICULTURE

Following the onset of more abundant rains at the end of March and throughout April, the *Isobertlinia globiflora* produced a strong honey flow. The onset of this honey flow inspired swarming, and despite the loss of eight pounds of bees from this cause, the Scale Hive at Talikwa gained seventy-two pounds in thirty-nine days.

By mid July, brood rearing had ceased in Western Province areas and the collecting of the beeswax and honey crop was in full swing. It was found that while hives which had been occupied since the previous year had good weights of surplus honey and beeswax, between seven and thirty-eight pounds of honey-comb, hives that had been occupied only that season had little or nothing to spare over and above their requirements for the period until flowering began.

The flowering of trees in favourable areas began extremely early, during August, and flowering continued into November. This long drawn out flowering period of most of the woodland trees resulted in a steady honey flow. This produced extensive breeding and a certain amount of swarming, but never could the bees collect much more nectar than was required for day to day consumption. As a result, the weight of the scale hive remained fairly steady during this period in contrast to the previous year when the more concentrated honey flow produced an increase of fifty-eight pounds in fifty-seven days between the end of October and mid December.

During the course of the year information was obtained on the development of workerbrood and the mating of queens, principally with the aid of a perspex observation hive.

BEEKEEPING

An appreciation of the value of preserving the brood nest and leaving food for the bees is spreading among the native beekeepers. Only in this way can the bee population of the territory be built up and the production of beeswax and honey increased.

Spreading interest in the keeping of bees has been shown by Europeans. The Southern Highlands Agricultural Show at Iringa contributed considerably to this. There are now some fifty Europeans keeping bees in frame hives or intending to do so in the near future. In addition to keeping these supplied with pamphlets, leaflets and other publications, advice has been given in response to inquiries from Zanzibar, Kenya, Uganda, Somaliland, Nigeria, Rhodesia and the Union of South Africa.

From observations made in Tanganyika, and from information received from adjoining territories, it would appear that the woodlands of Tanganyika are ideal for the practice of modern bee farming, particularly if the bee farms are run on migratory systems as in Australia.

PEST AND DISEASES

Up to the present none of the four principal diseases of bees has been detected in Tanganyika. The Union of South Africa has managed to keep itself free of two of the most important diseases by prohibiting the importation of bees, used beekeeping equipment, honey and preparations containing honey that are liable to introduce disease. In view of the improvement of transport facilities and the increasing interest in beekeeping in this territory it is highly desirable that the utmost precautions be taken at an early date to prevent the introduction of diseases of bees.

BEESWAX MARKETING

The 1950-1951 beeswax season has been very much better than the 1949-1950 season. Production this year has been about average. This improvement is due to better rainfall during the 1949-1950 rainy season than had been experienced in the two previous years.

The export figures for the past seven years are as follows:—

1944	...	...	627 tons.
1945	...	...	792 tons.
1946	...	...	732 tons.
1947	...	...	410 tons.
1948	...	...	905 tons.
1949	...	...	525 tons.
1950	...	...	315 tons.

At the beginning of the year the f.o.b. price of beeswax was £510 per ton. The price reached its peak of £750 per ton in early March 1951. Since then the price declined to £630 per ton at the end of March and £500 at the end of April, since when it has fluctuated round about this figure.

There has been a very marked improvement in the overall standard of beeswax exported from Tanganyika. The considerable amount of trouble previously experienced from adulteration with trigona wax and other substances, has been greatly reduced. An all out campaign against adulteration has been waged by the instructors in Central Province, which had been the seat of most of the trouble. All shippers were supplied with samples of commercial trigona wax to enable them to recognize it in their consignments and were provided with copies of the Preliminary Report on trigona wax.

In those areas of Western Province where there are Beekeeping Instructors permanently stationed, in Manyoni district of Central Province and in the beekeeping areas of Chunya district where Beekeeping Instructors are stationed, the improvement in the standard of beeswax brought to market has been remarkable, much of it would be a credit to a European Honey Show. In other areas of the Central Province, which are very backward, adulteration has almost disappeared, and the standard of beeswax has greatly improved, but it still has far to go before reaching Western Province standards. In those areas where there is insufficient staff or none at all, there is little noticeable improvement.

The value of employing local beekeepers who have been trained as Beekeeping Instructors has been amply demonstrated in the progress made in

improving beeswax. The scheduling of beeswax for sale in Native Authority Market, in some districts, has facilitated the work of the Instructors.

Despite the foregoing, there is still much room for improvement, not only in beekeeping areas that lack staff at present, but also in the handling by traders and shippers. Whereas future increase in instructing staff could deal with the former, application of revised Produce Export (Beeswax) Rules is required to improve the work of traders and shippers. The Revised Produce Export (Beeswax) Rules were drafted in November, 1951.

TRIGONA WAX

In order to obtain further information on Trigona Wax, and the bees producing it, collections of nests were made in Central and Eastern Provinces. It was found that this wax is produced by four larger species of *Trigona*, *T. denoti*, *T. togoensis*, *T. beccarii*, and *T. standingeri* in addition to two or more species of the minute *Trigona* of the subgenus *Hypotrigona*. The amounts of wax produced by the *T. Hypotrigona* species is too small to be of importance. The larger *Trigona* species however produced considerable quantities of wax. Samples of wax from these nests were sent to the Government Chemist, the Colonial Products Advisory Bureau, and industrial chemists, for analysis. The results did not show any significant difference in the waxes produced by different species. Trigona Wax is however so different from beeswax that no industrialist in Europe or U.S.A. could suggest a use for it. It has however been found locally to be of use in grafting, sealing the ends of cuttings as a joint compound for parts of machinery that do not become heated, and as modelling wax for use by children. There are probably many other practical uses for trigona wax where its freedom from a tendency to crack when set would be an advantage over beeswax where its stickiness would not be a nuisance.

The detailed descriptions of the larger Trigona species, their nests, and their waxes, have been submitted for publication.

HONEY MARKETING

The publication of a leaflet and the displays at Agricultural Shows, have aroused wide interest in the proper packing of honey. Inquiries have been received from private individuals and commercial firms. Leaflets on packing honey and notes on the operation of Honey Packing Stations have been supplied to all interested parties.

It has become clear that Tanganyika can only export honey if it produces a product that will compete with the best on the world market. The bees certainly do produce such a honey. In the past the honey has been ruined by bad handling and over processing. The honey produced by the bees has only to be separated from the wax and strained before packing. The application of heat or vacuum filtering is harmful to the quality of the honey. Consumers locally and in Europe want honey of good flavour and in an even, finely granulated, form. New Zealand caters for this demand by shipping only first class honey, of a safe density, minimum Specific

Gravity 1.420, and in set or granulated form. As a result their honey fetches the highest price and they have no difficulty in selling it.

To assist Tanganyika to enter the world market with her honey, it will be necessary to formulate Produce Export (Honey) Rules to lay down the minimum standards required of honey that is to be exported. These rules will be drawn up as soon as further data has been received.

EXTENSION WORK

A month's course was held for training beekeepers to be Beekeeping Instructors during January and February. This was followed by one week's refresher course in December.

The following leaflets, pamphlets and articles were published during 1951:—

“Preparation of Honey for Retail Sale” Leaflet 17.

“Sababu ya Kutowaangamiza Nyuki” Leaflet 18.

“Kutengeneza Nta ya Biashara” Leaflet 19.

“Notes for Beekeepers in Tanganyika” Pamphlet No. 50.

“Preliminary Report on Trigona Wax” *East African Agricultural Journal* April, 1951.

“Beekeeping Observations in Tanganyika, 1950/51” *East African Agricultural Journal*, October, 1951.

The following were written in 1951 and submitted for publication:—

“Mizinga”—Leaflet.

“Tumia Bomba la Moshi”—Leaflet.

“Trigona Bees and their Waxes”—Paper.

In addition memoranda were distributed to interested persons on Suggested Forms of Honey Packing Stations.

Displays of beeswax, honey, beeswax products, and equipment for Beeswax and Beekeeping, were given at the Sumbawanga, Singida and Iringa Agricultural Shows.

In the field the work of the Beekeeping Instructors has been concentrated first and foremost on improving the standard of preparation of beeswax, and secondly on teaching the necessity and value of preserving bee colonies.

BEEKEEPING FOREST RESERVE

The area at Talikwa used for studying beekeeping and sources of nectar was declared the “Talikwa Beekeeping Forest Reserve” under Government Notice No. 267 of 9/11/51.

BUILDINGS

The lack of laboratory facilities seriously hampered research work during the year, but the foundation of a Beekeeping Research Station near Tabora were laid.

Most of the Laboratory equipment ordered during the year arrived, but essential equipment for work on beeswax has not yet been supplied by the manufacturers.

F. G. SMITH,
Beeswax Officer

KILANGALI GRAIN FARM, REPORT FOR THE YEAR 1951

The production of rice under irrigation at Kilangali was first suggested in October, 1950, as a result of the decision that Government should start a direct food production scheme. As the area was considered to offer considerable promise for this development, with 5,000-6,000 acres of land available and an estimated twenty cusecs of water, the decision to proceed with a pilot scheme was taken on 2nd November, 1950. The object was "to experiment with a plan to utilize available water all the year round and to gain information on water duty rates and crop yields".

DEVELOPMENT

Equipment with which to make a start was obtained from surplus Overseas Food Corporation stocks, from ploughing schemes elsewhere in the Territory, and from the Custodian of Enemy Property. This arrived during January, 1951, but for the first three months transport was difficult and much work had to be done on machinery. Further equipment for the gradual extension of the scheme to 4,000 acres arrived during the year.

A temporary headquarters of mud-and-wattle, thatched houses comprising two European quarters, one Seychelles quarter, African married and unmarried quarters, office, stores, workshop and implement sheds was established during the year. The permanent building programme which was to have gone forward during the dry season, was deferred owing to the poor first harvest. As a result Europeans are living under extremely uncomfortable conditions and African quarters leave much to be desired.

Ploughing started on 11th January, 1951 with a D8 caterpillar tractor and Davis plough. This was, unavoidably, at least three months too late for the preparation of an adequate seedbed and for the seasonable sowing of the long-term crop.

Two hundred acres were ploughed before heavy rains delayed operations in February. As a result only 100 acres were eventually sown to rice and eighteen acres to maize, together with an experimental block of rice of ten acres.

Ninety-two acres of new land, and seventy acres of that first developed, were prepared in September and October and sown to rice in late October for a short-term crop. Thirty acres were planted with maize on ridges. Three hundred and sixty acres were also broken for sowing in January and February 1952.

Some light clearing of land for future development was done with the D8 Caterpillar before it broke down in July.

Several miles of approach road have been graded and gravel-filled in bad spots. As the road becomes impassable when the river floods, present communications are most unreliable during the rainy season.

CROP RESULTS

Rice.—The first fifty acres sown on 4th March, probably two months too late for optimum yields, grew well due to a good seedbed and early flooding. The second fifty acres sown on 13th March never grew as well, due to late irrigation and the uneven state of the ground. At harvest there were very marked differences between well and badly irrigated areas, and the need for most careful levelling cannot be overstressed.

Thirty acres only of the first fifty acres were eventually worth harvesting, due to uneven land leading to uneven irrigation and the excessively weedy state of the crop when cultivation had perforce been rushed. When cultivation had been thorough weeds generally gave no trouble at harvest. Although a swather was available, the pick-up attachment to the combine arrived too late to save the crop on the very weedy areas. One thousand and two hundred pounds per acre of paddy were harvested from the thirty acres. The later fifty acres and ten acres experimental plot were complete failures owing to damage by birds and rats.

The experimental plot of maize was a complete failure largely owing to waterlogging. It is doubtful whether maize could be successfully cultivated on the Kilangali soils except under irrigation in the dry season, when complete control of water would prevent waterlogging and permit inter-row cultivation.

The short-term rice on the old land has grown well where the land was reasonably level. It is, however, very patchy, and weed growth, chiefly sedges, is excessive in less well prepared areas. Complete flooding of bunds has been difficult as the vertical intervals are at present too great. The rice in the new land has not grown away well partly due to unavoidable delay in bringing irrigation to it due to damage to the furrow by the flooding of the river. When early flooding has been possible weeds are generally much less troublesome.

The maize crop will again be a failure due to waterlogging following heavy rains in November and the wet land preventing any satisfactory form of weeding. Much of the stand has died.

MECHANIZATION RESULTS

The first year has shown that :—

(i) In breaking virgin land of the type at Kilangali a very heavy plough is necessary. The Davis plough with D8 tractor has done this most satisfactorily.

(ii) Crawler tractors are necessary for all operations up to seeding, as the rough nature of the broken land is too hard on wheeled tractors.

(iii) T.D.9 tractors with 6-disc ploughs are ideal machines for all cultivation after breaking the land, and can be helped out by wheeled tractors at sowing.

(iv) Early ploughing and adequate seedbed preparation are essential aids to weed control. It is impossible to expect to obtain a good seedbed from virgin land of this type broken only six weeks before sowing. Adequate weed control may not be possible by only mechanical operations; early flooding and possibly chemical control may be further aids.

(v) Given reasonably weed-free crops, combines, with little modification can do a very good job of harvesting the varieties so far grown. In weedy crops a swather and pick-up attachment will be essential.

(vi) Mechanical levelling must be improved and increased. At present too much land is uneven, with poor rice on the high spots.

IRRIGATION, SURVEY AND SOIL SURVEY

The present water supply depends on a bolster weir and passage through the Native Authority furrow. In November heavy floods in the river Myombo broke round the weir and a later flood did further damage to repairs, as well as breaking into the main furrow. For a week there was no water, and for another week no control of the water flowing into the furrow.

A gauging point was established in the river by the Water Development Department in November 1951. At its lowest flow in 1949 it was estimated that thirty cusecs were available, of which ten cusecs might be required for the native area, leaving twenty cusecs for this scheme at that period.

Thanks to the co-operation by the Water Development Department some 2,000 acres of land lying in the development area were contour surveyed in May 1951. There is as yet no complete survey of the whole area on which must be based the siting of the new headworks and furrow.

Ten profile pits were sampled by the Agricultural Officer, Ilonga, in July and soil analyses made by the Government Chemist. These samples were not complete profile samples and further soil analyses are desirable.

The preliminary results show pH varying between 5.6 and 8.7 for the A horizon, increasing in all except one case from 7.2 to 8.25 at 5' 0". The following extracts are taken from the Government Chemist's report. "The Ca and P status are very variable and in one or two cases quite good. The risk of salinization under irrigation has to be kept in mind. Organic matter levels are generally low Plastic indices are generally high and the conclusion is reached that the main difficulty with these soils is mechanical It would appear . . . that the productivity of these soils is a problem of good soil management"

RAINFALL

The rainfall at the camp, three and a half miles from the nearest cultivation, during the period under review is shown in table I. The gauge was established on 18th February, 1951.

TABLE I

	<i>Days of rain</i>	<i>Rainfall in inches</i>
February	8	3.04
March	4	3.59
April	8	3.68
May	13	1.74
June	2	.11
July	0	Nil
August	3	.25
September	0	Nil
October	5	1.73
November	12	6.21
	55	20.35

CONCLUSIONS FROM THE YEAR'S WORK

The staff are to be warmly congratulated on the great drive and keenness shown in getting under way a scheme which started, unavoidably, at least three months too late for good results to be obtained from the first crop. They lived, and are living, under primitive pioneering conditions, they improvised, overcame considerable difficulties of supply and made an outstanding effort, and the comparative failure of their first attempt has been a great disappointment to them.

This year's work has shown that under far from ideal conditions there is promise for the success of the scheme. Where land was better prepared a not unsatisfactory crop was harvested for new land.

Sowing rice should not be delayed beyond the middle of February to avoid the check to the development of late rice which occurs in the cold weather in June. Preparation of new land should take place in the October to November season so that an adequate seedbed may be prepared.

Adequate levelling of the land is absolutely essential if even flooding is to be obtained, again demanding adequate time and machinery for the work.

Absolute control of irrigation water in the river, through the gates and main furrow, is essential if the rice is to be flooded at the optimum time and under strict control. New headworks are essential for this.

Row-cropping is unlikely to be successful in the long rains, when land becomes waterlogged, and is also suspect during the short rains. If maize can be grown economically here it will probably be a true dry-season crop.

Much experimental work is required relating to varieties, seed rates, methods of sowing, chemical weed control, the place of fertilizers in the scheme, rotations, etc. More needs to be known about the best methods of bunding, layout and control of water within the field.

ACKNOWLEDGMENT

The part played by the Regional Assistant Director of Agriculture, Morogoro, in planning and getting the scheme under way, in the selection of staff, and choice of machinery, should be placed on record. The detailed work entailed in opening up the scheme, in addition to normal routine work, threw a very considerable burden on an already busy office.

The Agricultural Officers, Kilosa and Ilonga, gave considerable assistance in survey and soil sampling, and the District Commissioner, Kilosa, has shown a keen interest in the development.

N. R. FUGGLES-COUCHMAN,
Agricultural Officer

SUMMARY OF THE REPORT OF THE EDUCATION OFFICER, INDIAN AGRICULTURAL SCHOOL, MOROGORO, FOR 1951

TERMS

The first term of work at the School ended in January, 1951; the second term followed without a break until the end of April. The third term was from the 1st June to 31st August; the fourth term, from 17th September to 21st December.

STUDENTS

Of the thirty students attending in January, 1951, twenty were from Tanganyika and ten from Kenya. In December, the respective numbers were fifteen and six. Their home towns were as follows:—

Dar es Salaam	...	9	...	Morogoro	...	1
Moshi	...	3	...	Mombasa	...	4
Iringa	...	2	...	Nairobi	...	2

The ability of the students varies widely. This wide variation is all the more apparent as some proportion of the students have a little difficulty in understanding the English language. Very few of the students have had previous knowledge or experience of farming.

It appears desirable, if sufficient applicants are forthcoming for future courses, that the average educational standard of students should be higher.

STAFF

The present Education Officer took over charge of the school from the previous Principal, Mr. K. H. Advani, on 25th January, 1951. The members of the staff during the year were Mr. H. W. Gondhalekar, Mr. L. S. d'Silva, assistant masters, Mr. L. Fernandes, Clerk, Mr. P. S. D. Albuquerque, Hostel Warden (appointed 1st May, 1951) and Mr. Andrew Raphael, Carpenter (appointed 16th November, 1950).

EQUIPMENT

In March, the school obtained a Dodge Pick-up. This transport assisted greatly in the running of the school, and also enabled the students to make visits to farms in the district.

As the school now has an electric supply (230 v, 50 kw), a film projector, and some form of epidiascope for projecting both slides and book illustrations, could be effectively used.

A considerable amount of equipment was received during the year. This consisted of laboratory, surveying, and beekeeping equipment, butter churn and worker, and incubator and brooder.

From time to time the school has used machinery from the Government Farm, Morogoro, and a Ferguson tractor was handed over to the school. However, there are certain items that are not yet available on the farm, so that it is not possible to give full instruction in the use of all implements.

TEACHING

The main subjects in the classroom teaching have been Crop Husbandry, Animal Husbandry and Agricultural Engineering. These subjects have been supplemented by lessons in Botany, Veterinary Science, Surveying, Soils and Manures, Elementary Plant Physiology, Seeds, Entomology and Plant Pathology.

Although it is often difficult to differentiate between knowledge that is useful and that which is of theoretical interest only, some of the lessons in the first two terms appear to have been too theoretical. This tendency was corrected.

The students were able to make a considerable number of valuable visits, mainly during the third term. A list of the visits made is appended (Appendix III).

T. K. PARRY,
Education Officer

SUMMARY OF THE ANNUAL REPORT OF THE AGRICULTURAL
OFFICER (EXPERIMENTS), SOUTHERN HIGHLANDS
PROVINCE, 1951

GENERAL

On the whole the year was a reasonably successful one from the experimental point of view. The rains were good, and rarely excessive in intensity which ensured a satisfactory wheat crop, and a good "take", with excellent subsequent growth, of tobacco. Useful results were obtained from the wheat fertilizer and fertilizer placement trials in Iringa district and also from the wheat variety trials in Mbeya district. Results from the tobacco experiments were less conclusive, but sufficiently useful to give clear pointers for lines to follow up in the 1952 programme. Probably the most valuable results of all were those obtained from the pyrethrum experiments at Uwemba, where the whole-hearted co-operation and interest of the growers in the work were most encouraging. Reports on all the main experiments were prepared, and only the main findings are summarized here.

Wheat.—The 1951 trials were simply designed, and aimed at establishing economic levels of fertilizer application. They were again carried out at Dabaga and Sao Hill. This time all phosphate fertilizers were "placed" in the seed furrow, following a technique developed in Kenya for such trials. The method simulates almost exactly the way in which fertilizer is placed by a combined seed and fertilizer drill. In addition to the main trial at each centre a small trial was planted to show the value of correct placement of fertilizer. The same amount of fertilizer was applied in three ways—broadcast, mixed with the seed, and "placed". The following are the details of the treatments in the trials:—

1. *Fertilizer Trials:*

1. Superphosphate at 50 lb. P_2O_5 per acre.
2. Superphosphate at 100 lb. P_2O_5 per acre.
3. Superphosphate at 50 lb. P_2O_5 per acre plus S/Ammonia at 21 lb. N per acre.
4. Superphosphate at 100 lb. P_2O_5 per acre plus S/Ammonia at 21 lb. N per acre.
5. Superphosphate at 50 lb. P_2O_5 per acre plus S/Ammonia at 21 lb. N per acre plus Muriate of Potash at 50 lb. K_2O per acre.
6. Sodaphosphate at 50 lb. P_2O_5 per acre.
7. Sodaphosphate at 100 lb. P_2O_5 per acre.
8. Pig Manure at 5 tons per acre.
9. Pig Manure at 5 tons per acre plus Superphosphate at 50 lb. P_2O_5 per acre.
10. Dutch Mixture (Fison's) at 50 lb. P_2O_5 per acre.
11. Control.

NOTE:

- (a) In all cases where Sulphate of Ammonia was applied, half was applied to the seedbed and half as a top dressing five weeks after planting.
- (b) With the exception of the top dressing of Sulphate of Ammonia all fertilizers were placed in the seed furrow and the wheat sown at 100 lb. per acre using a Planet Junior Seeder.

SUMMARY OF YIELDS AND PRICES PER ACRE

Notes on the table:

1. The cost of Sodaphosphate was not known. It was not available commercially locally, and the large quantities required per acre rendered it totally uneconomic at any distance from the source of supply (Uganda) at present.
2. The subsidized cost of fertilizer was taken at 50% of the full cost (ex-K.F.A. Iringa) although only Dutch Mixture was subsidized (at 50% cost).
3. In treatment 8 the cost of F.Y.M. was assessed at Shs. 10/- per ton. This gave Shs. 50/- for the treatment. Since F.Y.M. cannot be subsidized, the full cost was retained in the subsidized fertilizer cost column. This also applied to treatment 9 where only the cost of the phosphate was reduced by half.
4. The value of the crop was taken at Shs. 45/33 per 200 lb. (naked price) delivered Unga Limited, Iringa.
5. Kenya Settler was the variety used throughout the trials.

TREATMENT	DABAGA		SAO HILL		AVERAGE: DABAGA AND SAO HILL		COST OF FERTILIZER	
	Yield lb./a.	Value Shs.	Yield lb./a.	Value Shs.	Yield lb./a.	Value Shs.	Unsub- sidized Shs.	Subsi- dized Shs.
1	590	133-69	645	146-15	617	139-81	45-82	22-91
2	685	155-22	1,015	229-99	850	192-61	91-64	45-82
3	800	181-28	805	182-41	802	181-73	79-14	39-57
4	760	172-21	830	188-07	795	180-14	124-96	62-48
5	870	197-14	905	205-07	887	200-99	112-37	56-18
6	710	160-88	650	147-29	680	154-08	?	?
7	525	118-96	635	143-89	580	131-42	?	?
8	545	123-49	635	143-89	590	133-69	50-00	(say) 50-00
9	785	177-88	1,075	243-59	930	210-73	95-82	72-91
10	710	160-88	730	165-41	720	163-15	59-20	29-60
11	310	70-24	70	15-86	190	43-05	Nil	Nil
S.D.*	327-80	—	524-00	—	291-00	—	—	—

*Significant Difference $P = 0.05$.

A figure of Shs. 80/- per acre was taken as a completely arbitrary estimate for the cost of cultivation, seed, harvesting, etc., (but excluding fertilizer for which the costs are given above).

FERTILIZER PLACEMENT TRIALS

The 1950 fertilizer trials showed the importance of correct fertilizer placement. Accordingly two simple trials were planted this year largely to demonstrate visually the value of placement, but they also gave some useful figures. The treatments were limited to two fertilizers since the fertilizer trials proper were designed to give information on rates and types of fertilizer required, and in them all fertilizers applied on the seedbed were "placed".

TREATMENTS

1. Control.
2. Superphosphate at 50 lb. P_2O_5 per acre plus Sulphate of Ammonia at 21 lb. N per acre applied in admixture with the seed at sowing time.
3. Superphosphate and sulphate of Ammonia as above placed in the seed furrow and the seed then sown on top using a Planet Junior Seeder.

4. Superphosphate and Sulphate of Ammonia as above broadcast on surface and raked in before sowing.
5. Fison's Dutch Mixture at 50 lb. P_2O_5 per acre placed in the seed furrow as in treatment three above.

SUMMARY OF YIELDS AND PRICES PER ACRE

Notes on Table

1. All relevant notes for the table relating to the fertilizer trials apply to this table.
2. In these trials treatments two, three and four are the same (method of application two and four excepted) as treatment three in the Fertilizer Trials. Similarly treatment five here corresponds to treatment ten in the Fertilizer Trials.

TREATMENT	DABAGA		SAO HILL		AVERAGE: DABAGA AND SAO HILL		COST OF FERTI- LIZER	
	Yield lb./a.	Value Shs.	Yield lb./a.	Value Shs.	Yield lb./a.	Value Shs.	Unsub- sidized Shs.	Subsi- dized Shs.
1	215	48-71	135	30-59	175	39-65	Nil	Nil
2	605	137-09	610	138-22	607	137-54	79-14	39-57
3	605	137-09	840	190-34	722	163-60	79-14	39-57
4	390	88-37	415	94-03	402	91-09	79-14	39-57
5	630	142-75	760	172-21	695	157-48	59-20	29-60
S.D.* ...	145-6	—	297-8	—	164-5	—	—	—

*Significant Difference $P=0.05$.

Discussion.—The experiments proved to the hilt the value of correct placement of phosphate. Between placing and broadcasting the same quantity of fertilizer there was a difference in yield of 320 lb. of grain and at subsidized fertilizer rates correct placement converted a financial loss of Shs. 28/48 to a profit of Shs. 44/03 per acre, a total gain of Shs. 72/51.

Dutch Mixture again proved itself to be a suitable fertilizer for wheat in this trial, although yields generally were somewhat lower than those in the fertilizer trials above.

In the absence of a proper combined fertilizer and seed drill, mixing the fertilizer with the seed was definitely better than broadcasting it despite some damage to germination.

The figures show such striking differences that further discussion of them is unnecessary.

Wheat Variety Trials.—The following tables summarize the yields of the leading six varieties at each of two centres in Mbeya district. Altogether twenty-three varieties have been tried between 1949 and 1951.

Njiapanda (7,300 ft.)

Variety	Yield 1951	Av. Yield 1949-51
1. 291.J1.II	1,720	1,970
2. Regent 975.6. ...	1,720	1,849
3. 294.M.7.C.6.A. ...	1,620	1,780
4. 294.M.7.C.1.C. (Kenya Settler) ...	1,700	1,700
5. 337.BE.2.F.2 ...	1,520	1,678
6. Rhodesian Sabanero	1,610	1,585

Ugole (5,800 ft.)

1. 294.M.7.C.1.C. (Kenya Settler) ...	2,290 ...	2,290
2. 261.S.10.C.2.D. ...	2,020 ...	2,285
3. 291.J.1.II ...	1,720 ...	2,140
4. 44/W/34 ...	2,080 ...	2,080
5. 294.H.2.A.1 ...	1,650 ...	1,990
6. 338.AA.1.A.2 ...	1,820 ...	1,910

Tobacco.—The principal object of the 1951 tobacco experiments was to try to find a non-Amarello type of tobacco which could successfully be grown and cured under local conditions. In addition there were trials with fertilizers at various rates and applied at various times; a trial on the control of Cutworm using various insecticides; a trial on Eelworm control using Shell D-D soil fumigant; a large scale trial to demonstrate and test various methods of spacing. All the latter trials were carried out using the Amarello variety Ehlers which is the one commonly grown locally.

The season was on the whole a favourable one. Planting commenced about Christmas 1950 and the first barn was picked on 15th March—a month earlier than in 1950. Owing to wet and overcast conditions ripening was slow until mid-April when a spell of sunny weather brought on rapid ripening and made it difficult to cope with the mass of leaf which was ready for curing. Curing was completed by the end of May. Quality and yield of leaf was generally good as far as Ehlers was concerned. For other varieties there were wide variations in quality and yield.

Pests and diseases were not very serious. Cutworms were almost absent, which nullified the cutworm control trial. Eelworm was only serious in three areas, and fortunately none of these included any of the statistical trials except the eelworm control trial.

Variety Trials.—The superiority in quality of Ehlers and 219, which are both Amarello types, was very marked. 219 is superior to Ehlers in quality and price per pound but slightly below Ehlers in value per acre. All other varieties, except Waterberg Special, were difficult to cure and although reasonably good in yield were of poor quality so far as colour is concerned.

Fertilizer Trial.—Design: $3 \times 3 \times 3$ Single replication. Treatments: N.P.K. at the following levels:—N at 0 10, 20 lb. N per acre (S. Ammonia). P at 0 50, 100 lb. P_2O_5 per acre (Double Supers). K at 0 25, 50 lb. K_2O per acre (Muriate). Variety: Ehlers. The statistical analysis show no significant increases in yields resulting from the application of any one fertilizer. There is however an increase for Nitrogen which almost attains linear significance. There is a marked depressing effect on yields from the heavier Potash Level as compared with the yield where only the single level of Potash is applied. It is not significant, nor is the increase in yield resulting from the single application of Potash. Phosphate had no effect on yield at either level.

There was a significant interaction between N and K, the highest yield being obtained from K at the single level and N at the higher level. K at

the higher level markedly depressed yield with N at either level. K alone increased yield markedly (but not significantly) at single levels. Higher level had no additional effect.

The failure of the tobacco to respond to fertilizers as might be expected, may be attributed to the particularly favourable season, and to the fact that, given adequate rainfall, Ehlers is a variety that gives a heavy growth even without fertilizer.

Some highly significant effects were obtained when quality data (as judged by colour grading) were analysed. N at the single level improved quality from forty per cent to fifty-three per cent grades 1-5A over Control. The higher level of N slightly reduced quality again. There is also a significant interaction between Phosphate and Nitrogen. The effect of Phosphate alone on quality was not significant but when applied with Nitrogen (both at the single level) there was marked improvement in quality—an increase in grades 1-5A of twenty-five per cent over Control.

The application of Phosphate at the higher level with Nitrogen at the single level reduced quality slightly, and if both were used at the higher level the reduction in percentage grades 1-5A was about twenty-two per cent, as compared with both N and P at the single level. Similarly with Nitrogen at the higher level and Phosphate at the single level there was a reduction in quality of about fourteen per cent grades 1-5A, again as compared with both at the single level. Potash had no significant effect on quality either directly or in interaction.

Late fertilizer application.—A simple trial designed to test out the effect of applying fertilizer late in the season showed that it is neither economic nor desirable to apply fertilizer after the plants have started to grow vigorously i.e., when they have reached the eight leaf stage.

Spacing.—The following spacings were tested:—

W 3 feet $\times$ 3 feet = 4,840 plants per acre.

X $3\frac{1}{2}$ feet $\times$ 2 feet = 6,240 plants per acre.

Y Double rows with plants stagger planted at 2 feet $\times$ 2 feet with 4 feet between row pairs = 7,260 plants per acre.

Z Double rows with plants stagger-planted $2\frac{1}{2}$ feet (between rows) $\times$ 2 feet (between plants) with 4 feet between row pairs = 6,650 plants per acre.

Variety—Ehlers.		Yield/acre lb.		Value/acre Shs.		Price per lb.
W	...	1,222.68	...	1,602.59	...	1.31
X	...	1,390.40	...	1,997.36	...	1.43
Y	...	1,368.81	...	1,994.47	...	1.45
Z	...	1,535.80	...	2,308.94	...	1.50

EELWORM CONTROL

Yield.—There were no significant differences in yield between treated and untreated plots irrespective of whether seedbed and/or field had been treated.

Quality of Leaf.—There were no significant effects on quality resulting from treatment.

Degree of Eelworm infestation.—There were no significant differences between treatments in the percentage of plants *severely* affected by eelworm. Analysis of the *total* number of plants affected showed that there was a significant reduction in the number of plants affected resulting from treatment with D-D.

Pyrethrum.—The fertilizer and spacing trials started at Uwemba in Njombe district in 1949-50 were continued in 1951 for the recording of the second year's yields. In addition, a number of new problems were investigated. These included further work on fertilizers and spacing; strains and varieties of pyrethrum; seeding and watering rates for nurseries; methods of cultivation; times of planting; and system of picking the flowers. Some crosses were made between high-yielding, high pyrethrin-content clones. The main findings to date have been :—

1. Pyrethrum at Uwemba responds very significantly to Superphosphate. The increase in yield resulting from application of Supers is continued into the second year. Its use is highly economic.
2. Compost too gave appreciable increase in yield but its use may not be economic.
3. Lime, Sulphate of Ammonia and Muriate of Potash have no effect on yield.
4. Close spacing of the plants in the first year, on single-row ridges gives the highest yields. Thinning of the plants in the second year is desirable.
5. Locally selected strains give better yields than strains introduced from Kenya.
6. Application of phosphatic and nitrogenous fertilizer to the nursery soil is beneficial to seedlings.
7. Early planting greatly increases the yield in the first year as compared with late planting.
8. Clean weeding of pyrethrum is desirable and considerably increases yields.

J. S. GUNN,
Agricultural Officer (Expts.)

MOROGORO FARM REPORT

CROPPING—EXPERIMENTAL

(a) *Selection of Dwarf-type Sorghum.*—Two blocks of land, a total of 4·8 acres, were planted with Dwarf Enyanza variety. Planting was carried out in January, and harvesting took place in May. A total yield of 962 kilos per acre was obtained giving an average yield of 200 kilos. Selection was made for height and classified into tall, medium and dwarf. The dwarf type is being kept for seed and will be planted again and reselected during the next season.

(b) *Planting Dates for Enyanza Sorghum.*—A trial was also laid down to study the best time for planting. Results from experiments indicated that the most suitable time for planting was during the month of February. This experiment was not wholly significant as good rains fell during early February and very little in March itself.

The conclusion reached was planting should not be earlier than March as the short growing period of this sorghum would result in ripening of the crop before the end of the long rains if planted earlier.

(c) *Anti-Smut Trials.*—Trials were also laid down to test the use of various fungicides in the control of Smut.

Three fungicides were used and applied at the following rates:—

Sulphur : 1 oz. per 28 lb. of seed.

Nomersan : 25·4 grams per 28 lb. of seed.

T.M.T.D. 8·89 grams per 28 lb. of seed.

RESULTS

Block	1	2	3	4	5	6	
<i>Control:</i>							
Percent Smutted Heads...	51·9	2·6	39·0	27·7	46·6	66·6	Average
(Yields) lb. oz. ...	7·13	8·12	8·8	9·12	5·8	2·8	7·2
<i>Sulphur:</i>							
Percent Smutted Heads...	0	2·1	46·5	0	2·4	7·2	—
Yield ...	12	9·12	6·10	9·10	15·4	4·07	7·15
<i>Nomersan:</i>							
Percent Smutted Heads ...	0	0	15·8	0	5·4	0	—
Yield ...	14·4	10·4	7·14	12·8	4·8	2·0	8·9
<i>T.M.T.D.:</i>							
Percent Smutted Heads ...	0	2·4	0	0	0	10·7	—
Yield ...	10·10	10·8	12·8	10·8	7·0	15·15	9·7

Results of this experiment show the distinct advantage of seed dressing, with T.M.T.D. giving the most satisfactory results.

(d) *Manurial Trial on Maize.*—A trial was laid down by the Indian Schoolboys to test the effect of Nitrogen and Phosphate manures, on maize yields. Results were not significant and it was felt that the experiment was too complicated for schoolboys to have run successfully. The lay-out was large and too many fertilizers were used in the one experiment.

An experiment is planned for next season with only two manures and one control in a simple lay-out of randomized blocks.

(e) *Cassava*.—Planting of virus-free stocks of cassava was maintained during the year and quantities of cuttings were distributed to many parts of the Territory.

(f) *Rice*.—Five strains of rice were planted during the season to test for suitability and yield.

Five blocks were laid out, each twenty feet by twenty feet. The following were the yields :—

Type	Yield on plots		Yield per acre	
		Kilos		Kilos
Afaa, Moshi ...	...	19	...	2,209
Afaa, Morogoro ...	...	13	...	1,417
Meli ...	...	7	...	963
Lingwuaya...	...	2	...	318
Kihweta ...	...	4	...	436

The experiment was not laid out in replacated form, but soil conditions are consistent and figures given are an indication of the yield capacity of the five strains.

CROPPING GENERAL

(a) *Maize*.—4·7 acres were planted to multiply stocks of Katumbili and Durum varieties.

Total Produced : 1,500 kilos.

(b) *Sorghum*.—Apart from the 960 kilos sorghum received from the experimental blocks, a further two acres of Enyanza was planted and yielded 900 kilos. 450 kilos per acre.

(c) *Sunflower*.—Total yields for the year were 850 kilos of seed.

(d) *Kunde*.—The Enyanza Dwarf Sorghum was interplanted with Cowpea giving a total yield of 240 kilos from 4·8 acres. The following produce was used on the farm and sent to other parts of the Territory :—

Fed to Cattle:				Kilos
Maize ...	...	...	...	1,300
Sorghum ...	...	...	...	1,300
Sunflower ...	...	...	...	500

Dispatched to Planters and other Experimental Farms:

Maize ...	...	...	200
Sorghum ...	...	...	800
Rice ...	...	...	25
Sunflower ...	...	...	300
Cowpea ...	...	...	300
Various grasses ...	...	...	8 bags
Tropical Kudzu ...	...	...	½ bag
Cassava Cuttings ...	...	...	49
Potato Cuttings ...	...	...	bundles
			23
			bundles

CATTLE

Annual totals for milk:

Milk sold	Pints 13,537-5
Milk fed to calves ...	17,606-5
Total ...	31,144-0

Total Births:

Male	17
Female	22

Total Deaths:

Male	12
Female	6

Total Sales:

Male	12
Female	5

Health.—A bad outbreak of Trypanosomiasis occurred in June and yields of milk dropped considerably. The condition of the cattle was very bad for a few weeks, but by increasing the stock feed, the milk production rose and the condition of the herd became satisfactory. For the rest of the year, the health of the herd has been satisfactory and weekly blood-sliding has been strictly adhered to.

Breeding Policy.—This year, six cows and one bull were transferred from Tengeru Dairy farm to Morogoro. Two of these cows died when Trypanosomiasis broke out in June. The cattle lost condition when they arrived at first, but at present, after becoming accustomed to the change of climate, are in satisfactory condition. Considering the average age of these cattle was over nine years, they have done quite well and with the use of the Half-Bred Red-Poll Bull, and this nucleus of better quality cattle, the prospects of up-grading the herd are very good. However, in future introductions of stock it is recommended that heifers of two and a half to three years are purchased, or cows of one calf, as firstly they will stand up much better to change of climatic conditions and also a longer breeding life will be obtained. At present no bull calves are being held, all are sold at a few weeks old. The Half-Bred Red-Poll is being used as the sire and a black, good quality, Zebu is being kept in reserve.

Feeding.—Cotton seed and maize were used as the concentrate food up until the end of June, when stocks of cotton seed became exhausted. Since then, the ration has been of sorghum and maize in equal parts mixed with a small quantity of good sunflower seed. Hay and silage was made during the month of May and helped out well in the dry season.

Machinery.—The following machinery and implements are at present on the farm :—

- 2 Ferguson Tractors
- 1 Fixed Tine cultivator (Ferguson)
- 1 Disc Plough
- 1 Mould Board Plough
- 1 Mower (Ferguson)
- 1 Harrow (Ferguson)
- 2 Ox Cultivators
- 3 Ox Ploughs.

One tractor has been handed over to the Indian School of Agriculture for practical work. The tractors have been also used for ploughing in Native areas on a very small scale.

At present, mechanical cultivation can be maintained for ploughing and up to planting but the lack of a good Universal Planter curtails the amount of mechanical inter-row cultivation and labour forces on the farm have had to be maintained for planting and cleaning. The Farm has now a well equipped workshop and all repairs on tractors and G.T. transport are carried out on the farm, under the supervision of the Agricultural Assistant.

Nursery.—The following are the totals sold from the nurseries :—

<i>Plants</i>			<i>Fruits</i>		
Citrus	...	5,882	Grapefruits	...	2,700
Other Fruits	...	1,873	Oranges	...	1,300
Ornamentals	...	4,469	Lemons	...	900
			Limes	...	400
		12,224			5,300

The work in the nurseries has progressed and lemon seeds have been successfully planted in preparation for next season's budding.

In conclusion I wish to acknowledge the excellent work done by Mr. Joshi in the dispatch and sale of planting material and also the efficient work of Mr. Salehe Mhenga as Farm and Nursery Supervisor.

C. G. BIRCH,
Agricultural Officer

DODOMA TRIBAL FARM

Crops.—Good yields of grain were obtained. The following indicate the yields in lb. per acre of the crops (non experimental) grown for bulking.

	Acres	Lb. per acre	
Maize (Katumbili)	1.00	1,647	Lightly manured.
Maize (Bihawana)	0.95	1,513	Unmanured.
Green Gram	2.20	378	Unmanured.
Cowpeas	4.40	182	18 acres manured.
A. B. Millet	2.00	925½	Unmanured.
Dobbs Sorghum	1.70	2,368	Manured.

Millet Cultivation Trial.—This trial, which was a split-block one, with three cultivation methods—flat—ridge and tie ridge, both manured and unmanured, definitely shows the marked effect of manuring, but as the results have not as yet been statistically analyzed it is impossible to say whether there is any significant difference in the method of cultivation.

Results have indicated :—

Cultivation Method	Yields	
	Weight of grain lb. per acre	Weight of stover lb. per acre
Ridged Manured	1,108	2,618
Tie-ridged Manured	1,075	2,574
Flat Manured	1,050	2,134
Tie-ridge Unmanured	877	2,090
Ridged Unmanured	777	1,738
Flat Unmanured... ..	667	1,828

The difference between the yields from the different cultivation methods might be more marked in a drier year. From observations during growth, the order of "merit" followed that of the grain yields above—(as judged by colour, health, size, etc.). A fair amount of damage was caused by wind to the crops on the ridged plots.

Mulching Trial with Millet.—Millet stover was spread over the plots at the rates given below and a crop of millet sown Gogo fashion. The soil on the site is very poor.

	Yield
(a) Mulch at the rate of 8,100 lb. p.a.	285 lb. p.a. 29% increase over control.
(b) Mulch at the rate of 8,100 lb. p.a.	260 lb. p.a. 22% increase over control.
(c) No Mulch	190 Average of 202½ lb. p.a.
(d) No Mulch	215 Average of 202½ lb. p.a.

The increase in yield in the mulched plots is encouraging. There was little to choose between the plots according to observations before harvesting. It will be interesting to see if there is any cumulative effect from the same plots next season.

GROUNDNUT VARIETY TRIAL

Three varieties were planted and yields compared :—

	lb. p.a.	
Gogo (local)	1,618	(unshelled)
Valencia (ex Kongwa)	1,400	(unshelled)
Natal Common (ex Kongwa)	703	(unshelled)

SUNFLOWER VARIETY TRIAL

					<i>Per cent Stand</i>	<i>Theoretical Yield 100% Stand</i>
			lb. p.a.			lb. p.a.
Gogo (local)	...	...	587½	...	46	1,277
Polestar (ex Kongwa)	...	...	310	...	78	397
Jupiter (ex Kongwa)	...	...	270	...	91	294

Although the percentage stand of the local variety was low compared to that of the other two there was no comparison between the size of plants and flowers, hence the better yield.

SORGHUM VARIETY TRIAL (MANURED)

<i>Variety American Types</i>	<i>Yield in lbs. per acre</i>	<i>As percentage of Dobbs</i>
Plainsman ...	2,600	81.1
Swaziland ...	2,572	80.4
Ajax ...	2,147	67.0
Martin ...	2,147	67.0
Hegar ...	1,951	60.8
Early Hegar ...	1,809	56.4
D.Y. Milo ...	894	27.9
Dobbs Control...	3,205	100.0

EX KONGWA TYPES

Kano ...	4,109	122.1
Gogo ...	3,243	101.2
Feterita Managil ...	3,041	94.0
Potchefstroom...	2,747	85.6
Westland Milo...	2,507	78.2
Feterita Matuk ...	2,267	70.7

All but Gogo and Kaura are dwarf or semi-dwarf varieties. Kano, by far the best yielder, has a bright red grain which may not be acceptable to the Wagogo. Of the white seeded varieties Feterita Managil, and Swaziland appear to have the best possibilities. Local Wagogo natives reported the following to be palatable: Westland Milo, Feterita Managil, Plainsman and Potchestrom. These four are to be planted up in the coming season.

SMUT FUNGICIDE TRIAL

The trial, carried out for the third year again shows that three fungicides are greatly superior to the control.

<i>Fungicide</i>	<i>Number of Smutted Heads In Plot</i>	<i>Per Acre</i>
Sulphur ...	0	0
Nonersan ...	0	0
T.M.T.D. ...	0	0
Control ...	370	492

STOCK

The present stock figures are:—

Cows twenty-four; Work Oxen nine; Bull Calves twenty-nine; Heifer Calves thirty-two; Bull one; Donkeys five.—Total ninety-five.

During the year there were losses due to theft and lions at Nzinga, where all adult non-milking and yearling cattle graze during the dry season.

The bull calf obtained from Lyamungu is now ready for service. A number of old and inferior stock were sold during the year and some younger stock were purchased to replace them.

Milk production this year showed an improvement. The return from the sale of 6,456½ pints of milk totalled Shillings 1,628/60.

After reserves of seed for the farm had been put aside, and issues made to the N.A. food shamba, Prison, Mental Hospital, and Schools, the balance was sold on the market. Some seven tons of seed were sold for approximately Shillings 2,500/-.

